Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MC GRAW-HILL PUBLISHING COMPANY, INC.

Volume 75 NEW YORK, SATURDAY, MARCH 17, 1917 Number 11

The Railroad Strike

AS this page went to press the unofficial announcement came that the railway trainmen would strike to-day at 6 p. m. It appears that they are unwilling to await the decision of the Supreme Court on the constitutionality of the Adamson law, though this decision is expected any time now. According to the reported plan, the public will be given several days to adjust itself to the suspension of business, or to force the railroads to submission. This evening the freight men are to go out on a number of Eastern and Southern trunk lines; Monday, March 19, the remaining Eastern and Southern lines are to be included; Tuesday, the freight trainmen on the Western lines will be called out, while Wednesday, if the companies have any fight left, passenger service will be suspended. Thus Congress in two sessions has utterly failed to remove the danger of paralysis of industry, and in spite of the ignominious surrender of last August, the strike has not been prevented, but only postponed to a time when it can do more damage. The patriotism of the brotherhood leaders—this journal cannot believe they represent the spirit of the rank and file of the brotherhoods—in forcing their issue at such a time as this, when we should be absolutely united, needs no comment. It is to be hoped that the President will find a way to deal adequately with the situation, without delay or undue ceremony.

Ethics Through Examples

IT IS EVIDENT that the American Institute of Consulting Engineers recognizes, in its recently published solutions of ethical questions, that these things depend upon consideration of circumstance and consequence. The Institute removes the matter from the field of speculation and intuition and sides with the philosophic school which holds ethics to be positive and experimental. It is certain that while experience has shown that an authorized and definite code of conduct is generally subversive of moral stamina through its absorption of personal responsibility, still ethics must be made work-a-day to a considerable degree, for they can then, if not slavishly followed, serve as guiding lights, or as points of departure when a particular situation finds an individual unprepared by his own experience. Of course, no code can satisfy all conditions. Even the Kantian "categorical imperative" comes to defeat under a tension such as war brings. Engineering, like war, is in practice a far more developed complex than when considered speculatively and coldly as a science. When it enters the world of commerce it gathers the burdens of human nature, suffering the distress of the desire for gain, via the easiest way. Its problems become those of business as well as those of the laboratory. While certain modern schools of psychology seemingly have disproved the existence of the conscience, still it is impossible to deny that the pleasantness of life is almost entirely the contribution of virtuous conduct. So, to no matter what data of ethics one subscribes, the action of the Institute must be judged favorably and as a contribution to the greater good of the profession.

Safeguards at Drawspans

MANY engineers would consider that the practical limit of public protection at a drawbridge approach had been reached when the customary gate had been lowered, a bell rung and attention directed to a warning sign of more or less prominence. Not so with the engineers of the Chicago Bridge Department. They have gone to greater lengths in developing safety-first plans. On page 425 of this issue, F. H. Avery describes new gate devices designed to prevent accidents. The warning prior to the opening of the draw is given by a series of electric bulbs attached to the gates themselves and so strung across the entire roadway that an approaching automobile or electric railway car cannot fail to receive the flash in time. But even this is not considered sufficient, as it is assumed that carelessness is an inborn human characteristic which every designer must consider. A heavy sliding boom is therefore constructed to stop a 4000-lb. motor vehicle traveling 30 miles per hour. Accidents happen every day, but many of them, as observed at Chicago, could be averted. Designing engineers on bridges and other structures can save the expense of many damage suits.

Costilla Dam Construction

ANOTHER dam is being built in the Rocky Mountain country by the alternate small trench and ridge method. Despite the cost of the method, which is considered prohibitive by some engineers, the advantage of being able to control the amount of saturation in the small units and prevent any definite horizontal layers led the engineers on the Costilla Estates project to choose this type of construction, as described on page 430. A 100-ft. dam built on this same principle across the headwaters of the Rio Grande for the Farmers' Union four years ago has been successful. In the latter structure, described in the Engineering Record of Nov. 9, 1912, page 508, the earth section was built as a heavy blanket against a rock section because of the scarcity of earth in the vicinity. In the Costilla dam one of the interesting points is the use of heavy cast-iron pipes for outlets and to carry the flow of the river during construction, following the practice at the Standley Lake dam. It was vitally important that the outlet conduit be absolutely tight. Investigations indicated that the Union Pacific had placed many heavy fills over cast-iron pipe laid on concrete without cracking the pipe or breaking the joints. On the Costilla dam, however, the engineers took special precaution to lay the pipe on concrete cradles and introduced a slab support to take up the earth pressure. As a further safeguard the pipes were tested before being covered so as to determine the effectiveness of the calked joints. These measures to insure the permanency of the structure are well worth all they cost.

Reasons for Proficiency in English

IN AN ADDRESS delivered recently before the Association of Urban Universities, Alfred D. Flinn, deputy chief engineer of the New York Board of Water Supply, laid particular stress on the fact that if a young man aspires to the higher ranks of municipal engineering he must have a mastery of English sufficient to enable him to speak and write accurately, discriminatingly, and effectively. Particularly to the municipal engineer is this important, for he must prepare contracts and specifications clearly defining work to be done, and these should be written in such a manner that there will be a minimum of opportunity for dispute and complaint. He must be able to write and prepare special and periodic reports which should be interesting as well as informing. It is through them, and through them alone, that the intelligent support of the public can be obtained for projects or for work under way. He should have enough facility in the writing of clear understandable English to be able to prepare interviews or magazine articles through which he can gain and hold the intelligent support of the public. Further, he should be able to present engineering subjects orally to boards, committees or public gatherings in understandable terms and give unmistakable instructions. Somehow it seems that throughout the entire engineering profession men are continually arising to demand that the engineer prepare himself for higher duties than the mere routine performance of routine matters. In the presidential addresses before the annual meetings of national engineering societies for several years past this note has been persistently sounded. Among the members of the local engineering organizations the same sentiment is steadily spreading. There is the growing sense of a higher and further destiny for the engineer. His present inadequacy to the newer tasks being given him is becoming more and more apparent. Where will be found the agency through which this may be transmuted from a purely passive to a thoroughly active idealism?

The Fiscal Side of Paving

THE DECISION as to the selection of paving methods and materials often turns as much upon the engineer's knowledge of, or unreasoned preference for a particular combination as upon definite engineering considerations. In some cases the activity of the producing interests carries more weight than the actual ability of the pavement to meet the requirements. The points on the curve of value are few as yet, but pavement must be laid, and, if an extrapolation should prove to be incorrect, the engineer should not be criticized too severely for erring humanly.

It has become trite to mention the high speeds and unusual loads of motor trucks and to lay to their door the new problem. This is so proximate a cause that we overlook the freight elevator, for instance, which has made the rapid handling of large stores from congested warehouse districts possible. We are too apt to consider that present conditions will obtain always, that we must meet them as they are now manifest and determine with mathematical precision the economy of pavement types whose life is estimated at as much as 40 years.

But, to reiterate, pavements must be laid. We can neither follow the wild dreams of prophets who predict unique ways of handling commerce nor should we temporize and lay materials which patently will last less than a decade, merely on account of low first cost. Undoubtedly there will be a vast intensification of present traffic density and an increase in its destructiveness before a radical change in present methods of freight handling will be found unavoidable. In a situation such as now exists, every theoretical treatment of the fiscal problem of paving is timely and valuable, and such illustrative considerations as those of Mr. Connell's appearing on page 419 of this issue should receive intensive study.

Water Sales Promotion

A DOLLAR down and the balance in regular installments, or some other partial-payment plan, is the proposed new method of promoting the use of water. It is a rare thing to hear waterworks men discuss new-business possibilities, selling methods and all the other promotion measures of modern business. Nevertheless, a few water companies are "going after" business, instead of waiting for customers to beg the company to take their money.

In Indianapolis only two-thirds of the available water business is on the books of the company, and a recent investigation showed that some kind of a partial-payment plan would increase the business and, at the same time, eliminate insanitary conditions due to open vaults and unsafe wells. That sanitary engineers and health enthusiasts usually ride rough-shod over the opposition to sanitary progress by the poorer classes, without any attempt at a solution of the problem for the individual small-house owner, was the indictment served on sanitarians at a recent meeting of the Indiana Sanitary and Water Supply Association by a former newspaper man, now the publicity man for the local water company. It is his proposal, as set forth on page 416, to establish a partial-payment plan patterned after that so generally used by the gas and electric utilities. His scheme for financing sanitary improvements is the first public exposition of a serious study of Indianapolis conditions. The funding company, or branch of the existing company, has not yet been formed, but in all probability it will be established this year.

Undoubtedly there are unknown difficulties to be met, but no great errors need be made, for the more progressive utilities have paved the way. Discussions of the subject in this journal are invited and should be continued at coming waterworks conventions, for cities with municipally owned plants need the added impetus toward community health, even though they do not need the business. Not for some time has a more definite aid come to the sanitarian in his campaign for civic betterment.

New York Connecting Railroad Dedicated Last Week

WITH the dedication on March 9 of the New York Connecting Railroad was realized the dream of a quarter of a century—a direct rail connection via the Hell Gate bridge, between New England and the South. Twenty-five years ago was conceived the idea of this physical connection through New York City between the manufacturing centers of New England and the markets and sources of raw materials in the territory west and south of the Hudson River. Although other names than those of Samuel Rea and Gustav Lindenthal are associated with the earlier Hudson River bridge and the Steinway tunnel projects, which marked the beginnings of this scheme, only these two have remained to achieve final success and witness the fruition of their plans. In the presence of officials and engineers of the three railway systems concerned, the completed passenger connection, including the largest arch bridge in the world, was dedicated to the transportation service of the country and transferred to the New York, New Haven & Hartford Railroad Company, which is to have charge of its operation.

The section of the New York Connecting Railroad joining the New Haven at Port Morris in the Bronx with the Pennsylvania System at the Sunnyside Yard of the Long Island Railroad, over which the federal express between Washington and Boston will be restored to service within a short time, is about 6 miles in length. Of this distance, 3½ miles is occupied by the great steel arch bridge over Hell Gate and its steel and concrete viaduct approaches. Two tracks of this four-track line will be used for the operation of passenger trains. It is these tracks which are now to be opened to traffic.

Perhaps of greater economic importance, however, is the two-track freight branch which connects the road with the terminal yard at Bay Ridge, Brooklyn. Directly opposite the Greenville yards of the Pennsylvania Railroad, the connection at Bay Ridge with the New England lines will shorten the water transfer of freight in New York Harbor from 20 to 3½ miles. A short section of this line is still under construction. When it is finished, the delays and dangers of transferring freight by the tortuous water route through the East River and Hell Gate will be at an end.

State Compensation Laws Valid

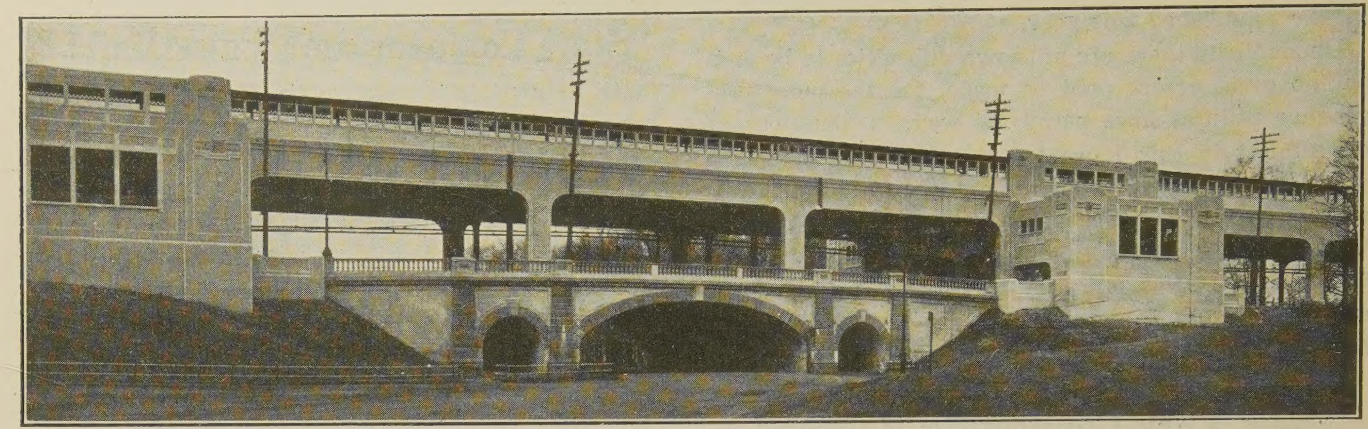
THE SUPREME COURT of the United States, in decisions handed down last week, upheld the workmen's compensation laws enacted by New York, Iowa and Washington. It is evident from these decisions that the right of states to enact laws compensating workmen injured in the discharge of duty without fault of the employer is unquestioned. In the decision regarding the case arising under the New York law it was also held that the New York Central Railroad, an interstate corporation, was liable under the state law rather than under the provisions of the federal employers' liability law for the death of an employee of its construction department whose duties were discharged wholly within the state of New York. The right of states to control compensation for injuries to industrial workers to the fullest extent is thus upheld.

While public assumption of the risks of industrial employment through state liability insurance, which has been upheld by the decisions, doubtless places everyone on an equal footing and does away with many of the injustices prevailing under the old system of redress at common law and private liability insurance, it must be borne in mind that neither this equality nor the prompt adjustment of accident claims is the final goal toward which those most interested in the problem of industrial accidents are striving. Such accidents are a net public loss, no matter how promptly or fairly the derangements resulting from them are adjusted. The object of all state or other regulation of the hazards of industry should be the ultimate elimination of accidents. Removing this problem from private insurance companies, which had already made a beginning of accident-prevention work, and turning it over to political administration does not mean that all the difficulties connected with it have been solved. It means rather that the legislators and the state executives under whose direction this work must go on must be brought to see, where they do not already recognize the principle, that the most important function of state regulation is not to compensate for injuries received but to prevent injuries and the necessity for compensation.

Readers of this journal who are employers should spare no effort to be of service in the work of making sure that the state administrations which have shouldered this problem approach it with the point of view here given. Should this view prevail, there is no doubt that the consideration of the question by the state governments as a public problem can result in greatly hastening the day when unnecessary risks now common to industrial employment will be things of the past.

Steel in New York Elevated Station Hidden by Ornamental Concrete

Arches Carry Jerome Avenue Line of Subway Extension at Mosholu Parkway Station—Inlaid Tile and Symmetrical Stair Towers Are Architectural Features



ONE of the structures recently constructed as part of the new dual system in New York City, mentioned by S. J. Vickers in the paper abstracted on page 267 of the Engineering Record of Feb. 17, describing how concrete ornamental elevated stations should be treated, was the Mosholu Parkway Station on the Jerome Avenue line. The structural details of this station, which was built above an existing concrete arch bridge carrying Jerome Avenue over Mosholu Parkway, were designed to conform to the special architectural treatment desired, including arched outlines for the concrete masking the steel girders, inlaid colored tile for surface treatment, and symmetrically placed stair houses with tower effects.

GENERAL LOCATION AND DIMENSIONS

Mosholu Parkway Station is located on Jerome Avenue between Mosholu Parkway south and Mosholu Parkway north, where the topography is undulating, including parks and driveways. Between the two parkways, Jerome Avenue is supported by a three-arch concrete viaduct, the center arch over a 60-ft. driveway and the two side arches over 14-ft. walks. The street level of Jerome Avenue is about 3 ft. above the crown of the center arch.

The station is 480 ft. long, symmetrically placed with respect to the arch viaduct, and supported on eight bents spaced 68 ft. 6 in. on centers, except that at the mezzanines and stair houses the spans are 55 ft. This spacing of about 68 ft. was adopted to bring the columns over the arch piers. Each bent consists of one 26-ft. center span and two side spans of 19 ft. 9 in., with four columns symmetrically placed about the center line of the avenue. The columns support outside longitudinal girders and cross-girders. The latter carry four interior longitudinal through girders 57, 60 and 69 in. deep. These through girders carry track floorbeams 30 in. deep, which support the three pairs of 20-in. and 24-in. I-beam track stringers spaced 5 ft. apart.

The width of the structure center to center of side columns, except at the mezzanines, is 65 ft. 6 in.; at the mezzanines the width is about 115 ft. 6 in. out to out of walls of the stair houses. The distance from the street level to the base of rail is about 27 ft. 6 in.; to the under side of the outside girders the distance is about 25 ft. In order to conceal the interior girders, the bottom of the outer girders is at least 1 ft. below the interior girders. The height of structure from street level to top of platform roof is about 40 ft.

WIDE OUTSIDE COLUMNS—STAIR HOUSES RESEMBLE TOWERS

The outside girders and columns are of special lattice design to give the massive concrete sections desired, and at the same time to afford a thorough grip on the steel. These outside columns are 5 ft. 6 in. wide, with circular brackets at the connection to the outside girders, which are 94 in. deep. All the outside steel being covered with concrete, the structure has the appearance of a series of flat arches, as seen in the photograph. At the mezzanines all the girders and columns are covered with a minimum of 2 in. of concrete. Between the mezzanines and beyond for the remainder of the station only the outside longitudinal girders and columns are incased. To prevent cracking and loosening of this concrete from the steel, which might be caused by vibration due to train movements, or by shrinkage, the concrete is tied to the steel by rod mesh reinforcement.

Four reinforced-concrete stair houses, with tower outlines, about 27 ft. high above street level, are symmetrically located longitudinally and transversely about the center lines of the structure and 260 ft. apart on centers. The west and east walls of these stair houses, 56 ft. long, are offset about 25 ft. from the center line of the outside columns of the main structure and 8 ft. east and west from the street lines. Their lower portions act as retaining walls to support the ground, which at this point slopes away from the structure. The walls above the street level inclose the stairs leading to the mezzanines, ticket booths, waiting rooms, etc.

The tops of the stair-house walls, where the danger of cracking from temperature variations is the greatest, are reinforced by means of built-up I-sections, which serve also to support the ends of beams carrying the roofs of the stair houses.

SHIELD WALLS HARMONIZE WITH STAIR HOUSES

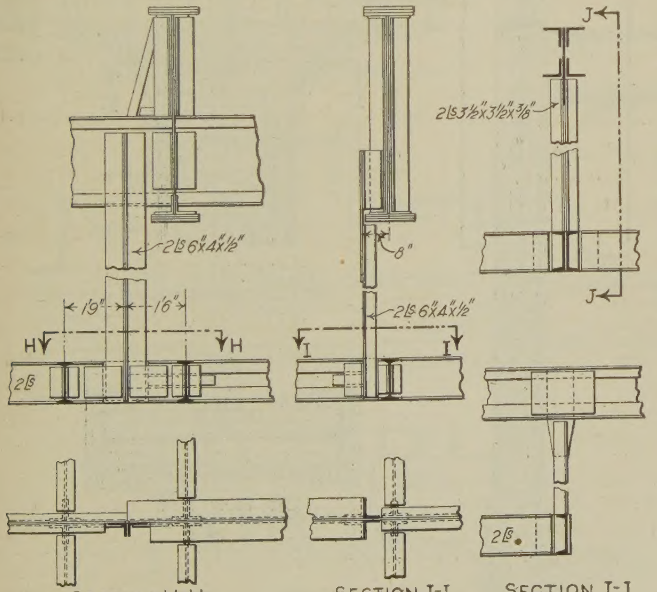
At the stair houses the platform shield walls are of reinforced-concrete construction extending from the roof of the stair houses to about 2 ft. above the roof of the platforms, and so designed as to harmonize with the tower features of the stair houses. These shield walls outside the mezzanines are of wood framing reaching from the platform to a sloping roof.

A transverse section through the station in front of the stair houses presents a view of an ornamental concrete structure supported on five flat arches. The structure over the roadway is about 9 ft. 6 in. deep, is supported on the three middle arches, and contains the mezzanines. The crowns of these arches, resting on four narrow concrete piers, are about 14 ft. above the street level. The span of the center arch is about 24 ft., that of the two side arches over the roadway about 18 ft. The extreme side arches over the sidewalks, of 16-ft. span, form the entrance to the stair houses. Alongside the main stair-house walls, and near the street lines, are provided eight retaining walls to support the sidewalks. These walls are finished on top with ornamental concrete fences to connect and harmonize with those of the concrete arch viaduct.

LOADING AND DESIGN ASSUMPTIONS

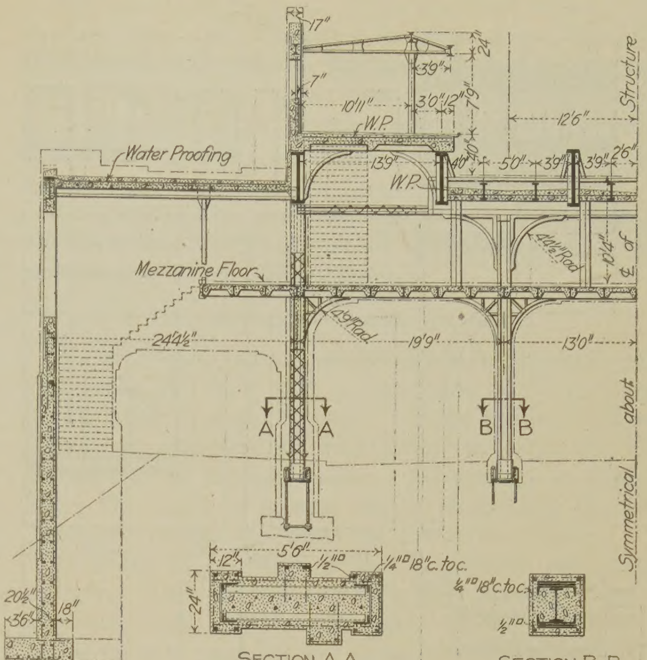
The live loading used for the design was a moving train of cars 52 ft. long on four-wheel trucks 36 ft. apart on centers loaded with 32,000 lb. per axle, increased for impact according to the well-known Public Service Commission formula. Platform and mezzanine live load was assumed at 100 lb. per square foot, including impact. The retaining walls were designed for a surcharge of about 4 ft. The earth pressure per square foot of wall was assumed at 33 lb. times the distance to top of surcharge.

The allowable unit stresses, as per the Public Service Commission's standard specifications, were decreased in some cases so as to avoid excessive deflection in the girders and thereby avoid injury to the concrete covering. Where steel framing covered with concrete was used, the steel was assumed to carry all the load, the concrete covering not being counted as taking stress.



SECTION H-H SECTION I-I SECTION J-J

CONNECTION DETAILS—HANGERS FOR MEZZANINE FLOORBEAMS



SECTION A-A SECTION B-B

HALF CROSS-SECTION TAKEN THROUGH STAIR HOUSE

EXPANSION JOINTS

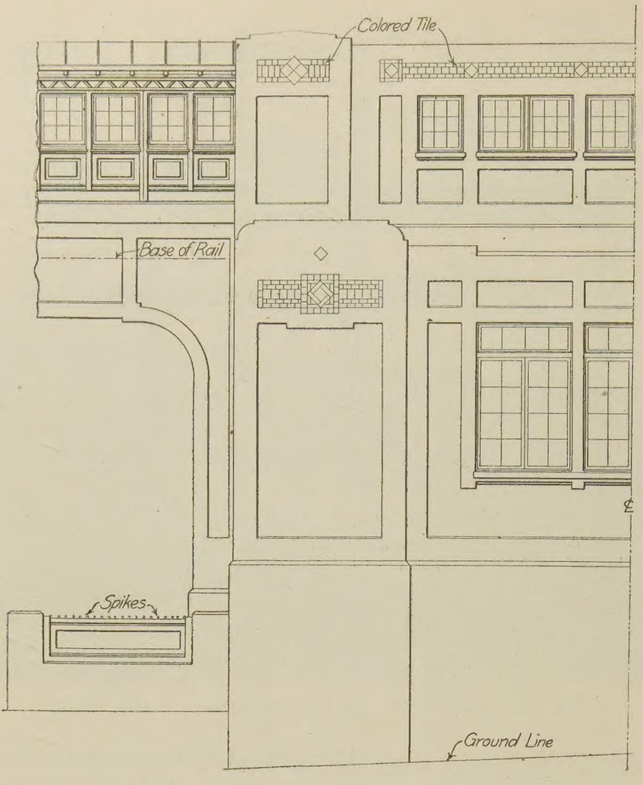
Four expansion joints are provided in the track floor steel, two just outside the ends of the middle span and two just inside the end bents. Only two expansion joints are provided in the outside longitudinal girders and platform roof, opposite the two middle expansion joints of the track floor.

The expansion joints in the outside longitudinal girders offered some difficulties, as it was objectionable to have an opening in the concrete exposed to view or to interrupt the architectural features of the exposed faces of the structure. These difficulties were overcome by attaching to the stiffeners of the girders at the expansion joints plates fitting the outlines of the structure and covering the gap in the concrete, as illustrated in one of the drawings. To conceal the difference in the appearance of the materials, the plates were painted to blend with the rest of the structure. The eight retaining walls alongside the stair houses are keyed in with the main stair-house walls by means of depressions filled with elastic cement, to allow for expansion.

WATERPROOFING AND RETAINING WALLS

In order to prevent water from leaking through the expansion joints in the walls and discoloring the exposed faces, three-ply waterproofing was placed at the joints on the faces of the walls in contact with the ground. Three-ply waterproofing was also used over the mezzanine roofs below the tracks and over the stair-house roofs, placed on top of concrete of 6-in. minimum thickness, and protected by a concrete slab of 4-in. minimum thickness.

All the walls, with their foundations, are of inverted T-sections. Their reinforcement consists of 1¼-in. deformed rods to resist the main stresses and ⅝-in. deformed rods to provide for temperature stresses. The

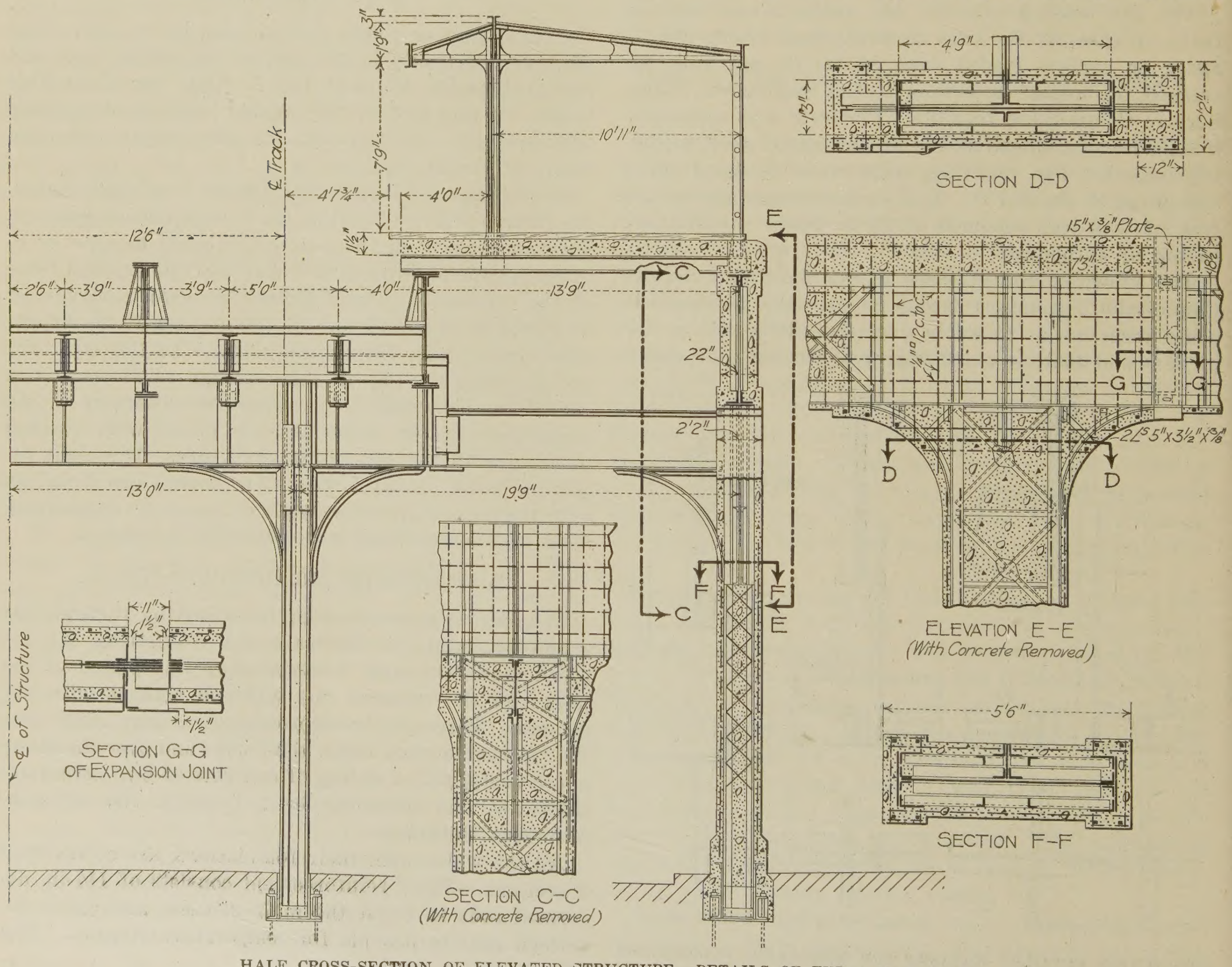


INLAID-TILE DESIGN ON STAIR HOUSE

temperature rods were spaced closer at the top of the walls, where it was thought the breaking up of the concrete is more liable to occur.

The column footings, except those over the arch viaduct, consist of concrete piers extending to a minimum depth of 10 ft. below the street level. The bearing on soil under the foundations was not allowed to exceed 4 tons per square foot. An investigation of the pressure under the existing concrete arch viaduct piers showed that, due to the loading of the viaduct proper, 3 tons per square foot was not exceeded. The additional load from the elevated structure, including dead load, live load and impact, amounted to 1 ton per square foot, causing a total pressure on the soil under these piers of 4 tons per square foot maximum, which was considered to be safe.

This station is on Route 16, Section 2, of the River and Jerome Avenue line, to be operated by the Interborough Rapid Transit Company in connection with the Seventh Avenue-Lexington Avenue Subway, and is part of the Dual System. It was designed by the engineering staff of the Public Service Commission, of which Daniel L. Turner is acting chief engineer; Robert Ridgway, engineer of subway construction; Sverre Dahm, acting deputy engineer of subway construction and A. I. Raisman, engineer of designs. The architectural design was made under the direction of S. J. Vickers, designing architect, and the structural plans were prepared under supervision of John Cooperstock, designing engineer.



HALF CROSS-SECTION OF ELEVATED STRUCTURE—DETAILS OF EXPANSION JOINT

Steel Construction Recommended for Chicago's Subway

Crossings of Two Tubes Over Illinois Tunnel Will Involve Incorporation of Latter in Floor System of New Structure

TYPICAL cross-sections and station layouts for Chicago's recommended subway system are presented by the Chicago Traction and Subway Commission in the supplement to its main report. The standard high-level subway section (for the elevated trains) is designed with roof beams spaced 5 ft. on centers, and with concrete jack arches between them to carry the street load. The roof beams are supported on columns between tracks and I-beam columns in the side walls. The commission states that experience in New York indicates this type to be generally preferable to a reinforced-concrete design, particularly where the construction is carried on under important business streets—it being more conveniently and quickly erected, as well as being more economical.

At station platforms the steel columns are spaced farther apart and sufficiently back from the edge of the platform to reduce interference with passengers loading and unloading from trains.

The structural features of the low-level subway (for surface cars) are identical with those of the high-level tube, except that heavier sections are employed to take care of the heavier loads. The floor construction may, in addition, include I-beam reinforcement to resist hydrostatic pressure where soft material and pockets are encountered.

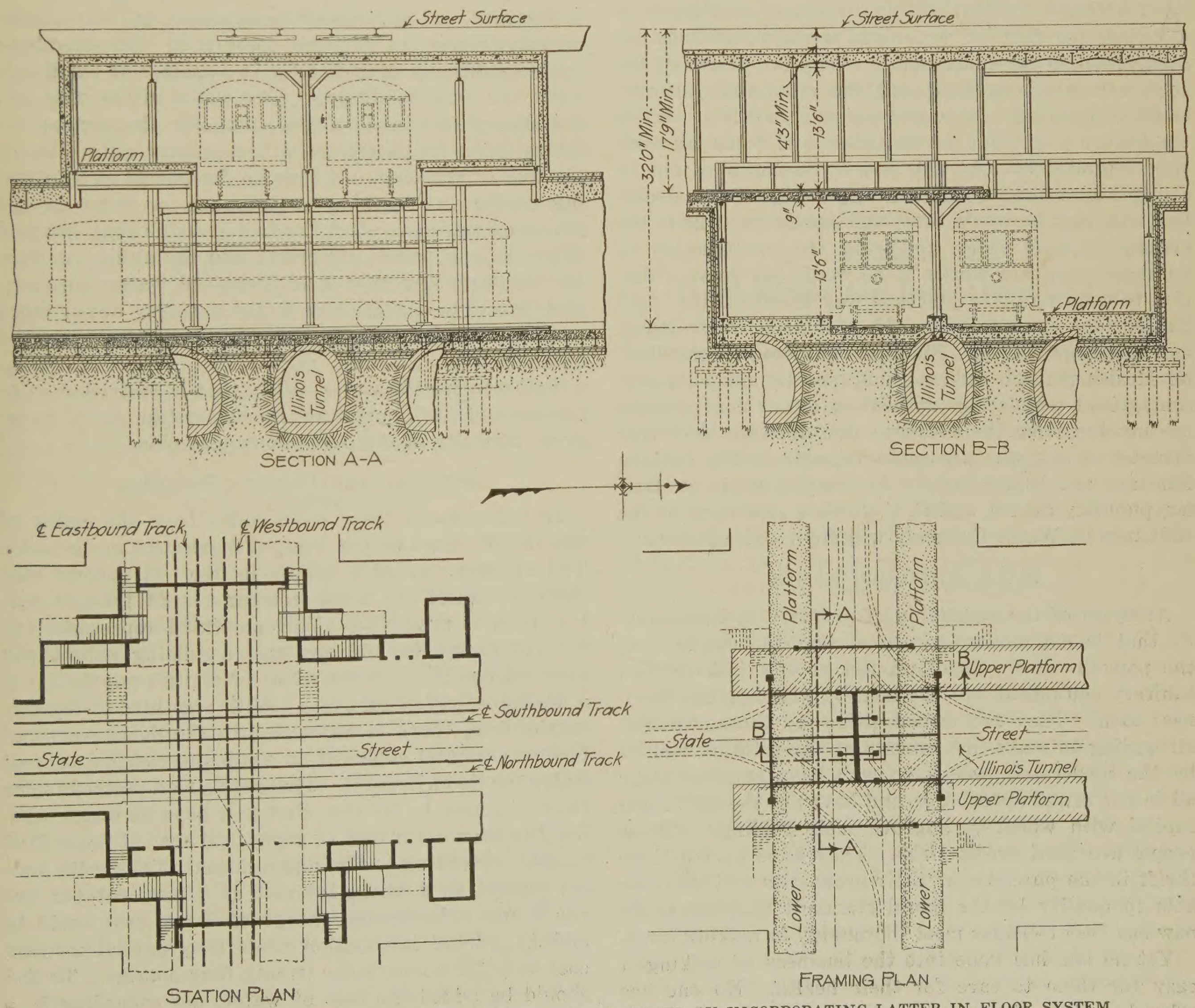
In general the stations are designed for ten-car trains, with platforms from 450 to 500 ft. long, with a minimum width of 12 ft.

WATERPROOFING AND DRAINAGE

Waterproofing is to be accomplished by enveloping the roof walls and floor with a membrane of woven fabric laid in pitch or asphalt mastic. In the low-level subway it may be necessary to waterproof the structure with bricks laid in asphalt mastic. All seepage is drained along the track to sumps, where electrically operated automatic pumps discharge the water into sewers.

In order to maintain proper ventilation, the tracks carrying traffic in opposite directions are separated by a curtain wall. The piston action of the train will be relied upon to push the air ahead and produce a suction behind the train, drawing the air in at the stations and expelling it at openings located between stations.

Between stations, standard track construction is rec-



SECTION A-A

SECTION B-B

STATION PLAN

FRAMING PLAN

CROSSING OF SUBWAYS OVER ILLINOIS TUNNEL ACCOMPLISHED BY INCORPORATING LATTER IN FLOOR SYSTEM ommended with ties laid in rock ballast, placed in troughs of the subway floor. At stations unballasted track is recommended, the rails being laid on short tie pieces bolted to the concrete bed.

Perhaps the most complex problems of design come at the crossings of the two subways. The low-level subway for surface cars will pass under the State Street subway for elevated trains at two points. At both points the Illinois tunnel (for small freight cars) occupies both streets, crossing at grade and being provided with Y connections. In order to get sufficient headroom in both passenger subways, and also to allow a sufficient deck to carry the street, it will be necessary to incorporate the Illinois tunnel in the floor of the low-level subway. The illustration shows how this can be done.

William Barclay Parsons, Robert Ridgway and Bion J. Arnold constitute the Chicago Traction and Subway Commission.

Funding Company to Promote Water Sales and Sanitation

Installment Plan of Payment for Water and Sewer Connections Modeled After That Used by Gas and Electric Utilities

A PARTIAL-PAYMENT plan for the installation of plumbing fixtures, water and sewer connections has been proposed for Indianapolis. Only two-thirds of the city is now so supplied, and the remaining business looks tempting to the water-company officials. While the failure to provide an easy means of financing sanitary improvements by the poorer classes may not be charged up entirely to the sanitary engineer, it is doubtless true that he would often see quicker returns in decreased typhoid rates, following the construction of municipal sanitary works, if he would pay more attention to working out a practical way by which the small householder can avail himself of a good water-supply and sewerage system. Statistics gathered by the Public Health Service indicate that the Indianapolis percentages of population without sanitary conveniences are not far from the average; therefore the following abstract of a paper presented recently to the Indiana Sanitary and Water Supply Association by R. A. Butler, publicity expert, and F. C. Jordan, secretary, of the Indianapolis Water Company will apply quite generally.

MAKE SANITATION EASIER

Analyses of the ownership of property in Indianapolis that is not modern reveal a condition contrary to the popular view. Small properties that lack modern sanitary equipment are not held by grasping big business men. They are owned either by those who are struggling to make investments at the ratio of rent or by the moderately well-to-do who have invested their all in one rental speculation and have not the additional capital with which to improve their holdings. These people are good credit risks. They have shown their thrift in the purchase of their properties and they are able to qualify by the moral standard that financiers now say they consider most thoroughly in making loans.

Yet no one has gone into the business of making it easy for them to care for their health. No one has offered to them the advantages now offered to the man of moderate means who would own a touring car. The opportunities of financing modern sanitary necessities have long been neglected.

Why not make it possible for the man who owns a small property to have sanitary plumbing installed in his home and the cost thereof extended over a reasonable period? Electric-light companies are wiring homes for electricity on this theory. Gas companies are installing ranges on payments. They have the sales and the collection systems already in operation, and the addition of appliance accounts is simple and involves little cost. The manager of the Peoples Gas Light & Coke Company, of Chicago, recently asserted that the greater agency of development in the gas manufacturer's field to-day was the partial-payment plan of selling appliances. His company has more than 600,000 of these partial-payment accounts on its books.

This same method of financing can and will be applied to water service and modern sanitary improvements in the near future. It is a problem that confronts water companies all over the country, and it is a solution that means more services on their mains, the use of more water and the improvement of the health of whole communities.

APPLIES TO MUNICIPALLY OWNED PLANTS TOO

Whether or not water companies or municipally owned waterworks systems embark in the plumbing business directly or indirectly is a matter of small moment and local conditions. The water utility that undertakes plumbing as a side issue for the purpose of intensifying its patronage will encounter difficulties in the way of criticism. It may be denounced as a grasping corporation seeking to establish a trust in the plumbing business. But the fact remains that, because of its buying power, its credit and the ability to wait for its profit and take it in increased water consumption, it will be able to give to the property owner more satisfactory plumbing at less cost than it can now be obtained.

But even for the water utility that is restricted as to business by its charter or its ownership, there is no great difficulty in the partial-payment plan.

PRESENT AND POSSIBLE BUSINESS

In Indianapolis there is an outlet from the mains of the water company for every 7.5 persons in the city. The average size of a family is five. It follows that the business of the water company is 33 1/3 per cent less than it might be. This one-third represents the field of prospects, and any merchandising expert will say that one-third of the whole of a city's population is a desirable field to cultivate. With one-third of the city as the field, there is necessary, to the development of business, capital sufficient to equip the possible user of water for its enjoyment. The installation desired in the class of homes in the city, that now have no water service, has been estimated at a physical cost of from $100 to $250, according to size and location. Taking the lowest figures as a basis, interest at 6 per cent for two years and a brokerage charge of 6 per cent could be added, and the installation made at a partial-payment cost of $4.92 a month for twenty-four months. To this should be added the cost of water, not exceeding $1 a month, making in all a charge against the property of

$5.92 a month, or approximately 19.7 cents a day. This should prove a fairly attractive proposition for the man with a small property whose concern is a safe water supply such as is furnished by water utilities. Other advantages, such as baths and toilets, will follow quickly on the heels of the first installations, and their costs will be relatively small.

Brokerage charges should be no greater for the large installation than for the small, if based on cost, but policy might dictate a sliding scale in order that first costs of installation be reduced.

FUNDING COMPANY SUGGESTED

The organization of a funding company with capacity to handle this business should not be difficult. Capital would, of course, demand an ample margin of security, but it is the opinion of legal authorities that this security could easily be provided.

Organization and operation of the funding company are possible at a very small overhead cost. The amount of capital actually necessary is dependent on the size of the field, but a consideration not to be overlooked is the fact that each month brings part of the capital back for reinvestment and with each monthly payment the individual account becomes more secure.

Operating expenses of the funding company would consist of three branches—promotion of business, investigation of risks, and collection. The expenditure necessary for the promotion of business will depend on the method of operation finally adopted.

Investigation shows that the great cost involved in installations such as are under consideration is not the plumbing but the sanitary sewer, the very thing that sanitation demands. This cost is not one of material but of labor, and probably no one plumber has any advantage over another in doing it. Plumbing is largely a matter of labor, and in most communities is so restricted by ordinance that it must be made standard. Fixtures furnish the greatest opportunity for cost reduction by purchase in bulk, but there are other advantages to be considered in determining whether a funding company should work in conjunction with all local plumbers or take over plumbing as a part of its business.

MAKE PLUMBERS BOOST

In the automobile business it has been found more desirable to have the funding company separate from the sales agency, in name at least. Perhaps this would be more advisable in sanitary funding. Certain it is that if the funding company were holding out to each plumber an opportunity to do work and collect his money immediately, even though the employer is not in a position to pay him cash, every plumber in the community would become an enthusiastic salesman and the cost of sales would be greatly reduced for the funding company.

The ideal situation seems to involve the organization of a company with sufficient capital or financial backing to be able to say to the property owner, "Hire any plumber you choose and select any fixtures you desire. We will pay the entire cost and give you two years in which to repay us."

Then, with the plumbers of a city the enthusiastic boosters of the funding company, the examination of the risks is the next important operating detail. It has been estimated that this work can be accomplished at a minimum fee of $5 a risk. The burden of showing title to the property is to be thrown on the applicant for a contract, and extensive investigation is not necessary. A manager of ordinary intelligence would be capable of judging the advisability of the contract and a single inspection of the property should be sufficient to satisfy him. The time element is not important and his work could be so distributed as to make it least expensive.

COLLECTION PROBLEM EASY

For convenience of collection the water rental and the partial-payment should be payable at the same place, the lessee being billed for the total and the utility holding the funding company responsible for the water rental. A simple card system of bookkeeping and a stenographer supplied with suitable letter forms for prodding the delinquents should accomplish the collections without great expense.

Whenever it is possible for the small property owner to improve his property without shouldering a hardship in the form of a big initial expenditure, it will be easier to insist on sanitary improvements. The greatest argument against the condemnation of open vaults and unsafe wells will disappear. Laws designed to wipe out these breeders of disease will not be assailable on the grounds that they are confiscatory. Property owners will benefit by increased value of their holdings. Renters will find properties more desirable. Water utilities will cut down their fixed charges as they increase the number of their patrons. Improved sanitation will bring about better health and there will be far more individual effort toward community health.

Good Roads Are Increasing in Cost

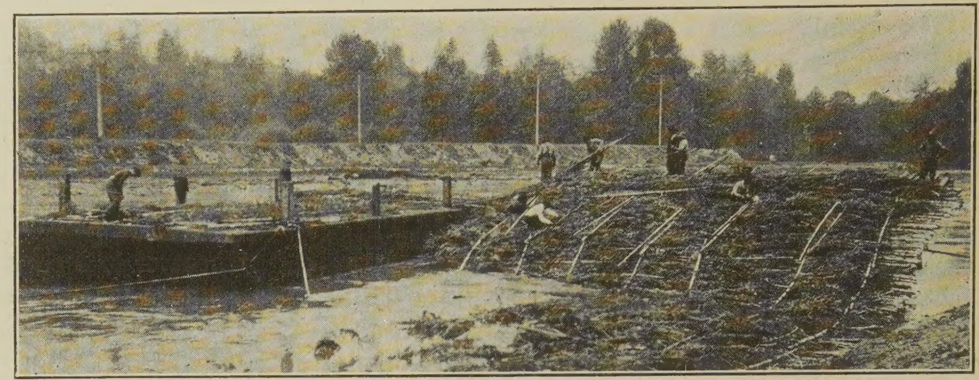
The Michigan State Highway Department recently reviewed its work during the last ten years and discovered some instructive figures of the increase in cost of road building during this period. These figures have just been made public by the American Highway Association. The state has large, widely distributed deposits of good gravel for road-building, and many miles of gravel roads have been built. In 1905 the average cost of this gravel was 12 cents per cubic yard; to-day it is about 30 cents per cubic yard at the pit. In 1905 ordinary labor was paid $1.75 to $2 per day, and $3 per day was paid for team hire; to-day ordinary labor is paid $2.25 to $3 per day and a team costs $5 to $6 per day. The state has also built many miles of macadam roads in the last ten years, and they have been increasing in cost like the gravel roads. In this case the increase has been mainly due to the mounting charge for labor, because the cost of broken stone has increased only from $1.30 to $1.50 per cubic yard. From these figures the conclusion is drawn that it is more important than ever before to employ labor and materials in the best manner, for inefficiency and carelessness now mean a larger waste of public funds than when prices were lower. A competent road builder now saves his salary many times over by stopping the leaks that occur under incompetent supervision, however honest it may be.

Brush Mattresses Floated from Sloping Platform

Rockfill Sinks Mats After They Are Launched to Protect Channel Bank on Stuck-Puyallup Project, Near Seattle

THE NEW CHANNEL dredged for the Puyallup River in the Stuck-Puyallup improvement project near Seattle, described in the Engineering Record of Nov. 11, 1916, page 587, required that the banks be protected from current and wave action, particularly along the lower stretches. The revetment work was divided into two parts—the subaqueous brush mattress and the concrete paving above low-water level. Both operations were carried on from barges.

To facilitate the construction of the brush mattress, which is 40 ft. wide and about 6 in. thick, a sloping platform was built on the deck of a barge. This was called a "catamaran." By advancing this catamaran downstream, the completed portion of the mattress readily floated off the platform, making way for the construction of another length. By this method joints were avoided.

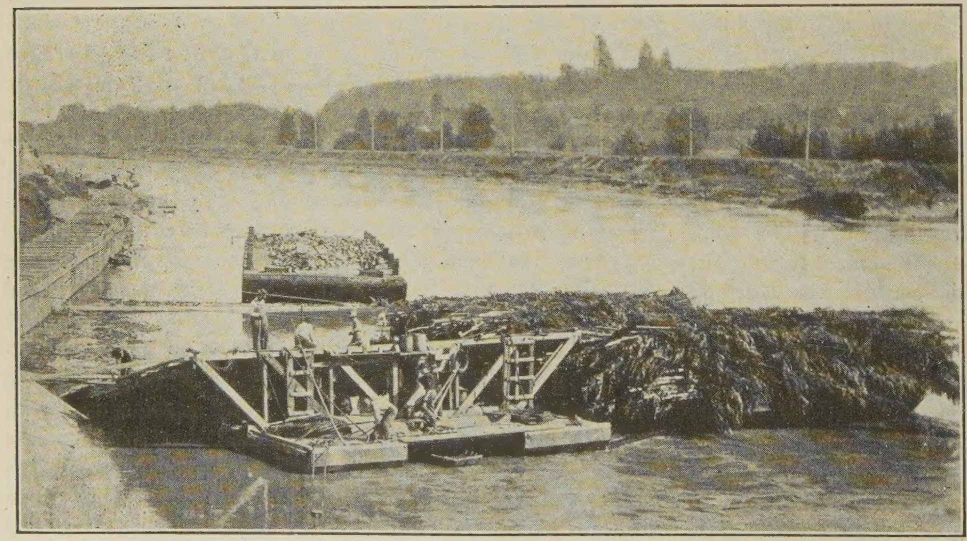


WEAVERS AT WORK—UPSTREAM SIDE OF SLOPING PLATFORM

Two 1¼-in. cables were run through the mattress and seven longitudinal lines of poles were stitched into it at 6-ft. intervals with No. 6 annealed wire. The brush for the mattress was delivered on scows at $2.20 per cord and the cost per linear foot in place of 6245 lin. ft. of the mattress was as given in the table.

COST OF MATTRESS PER LINEAR FOOT

6-in. by 40-ft. brush (0.345 cord per foot) at $2.20 per cord	$0.76
Wire, nails, staples	.067
Cable	.043
Labor	.369
Depreciation and tools	.039
Rental, towage, demurrage	.007
Total per linear foot in place	$1.285



BARGES OF BRUSH WERE TOWED ALONGSIDE CATAMARAN

After being floated and the shore end fastened in place, rock ballast was dumped on the mattress. This was delivered on scows ranging in capacity from 100 to 200 tons, at $1.85 per ton. The amount of ballast used and the costs for ballasting 6245 ft. were as follows: 0.547 ton per foot at $1.85 per ton, $1.01; labor, 18 cents; depreciation, tools, etc., $0.029; total per linear foot in place, $1.219.

Having finished the work on the brush mattress, another barge, on which was mounted the concrete-mixing equipment, was towed along the shore and a 4-in. concrete pavement placed on the slope between the brush mattress and the top of the bank. The scow carried a 10-cu. ft. Smith mixer operated by a gasoline engine. The materials were delivered on barges brought to the stream side of the mixer barge.

The price of cement delivered on the work was $1.76 per barrel; gravel, $1.15 per cubic yard; and sand, $1.15 per cubic yard. The mix was 1:3:6. The average cost of the concrete was $5 per cubic yard in place, or 55 cents per square yard.

The work was carried out under the direction of W. J. Roberts, chief engineer of the Inter-County River Improvement.

Panama Canal Costs Are Double Revenue

Including the 1253 ships making the transit in 1916, the total number of ships which used the Panama Canal in the time from its opening in 1914 to Jan. 1, 1917, was 2780, according to the *Panama Canal Record.* Their gross and net canal tonnages were 13,086,535 and 9,209,503 respectively. The total quantity of cargo which was carried through the canal was 11,652,405 tons. The number of ships passing through the canal in 1916 exceeded by 83 the number (1170) making the transit in the year 1915. The aggregate revenue from tolls for the year 1916 was $3,677,695.60. The cost of operation and maintenance for the same period was $7,142,124.05.

How to Determine the Annual Unit Cost of Pavements

W. H. Connell Analyzes Conditions Under Which One Type of Pavement Is More Economical Than Another

THERE has been considerable discussion relative to the advisability of paying the entire cost of repaving out of current taxes. Such a method of financing, of course, would result in a lower annual cost to the city because there would be no loan interest charges to pay, it being necessary only to set aside a certain sum annually as a sinking fund to replace the pavement at the end of its economical life. While this method results in adding to the city's assets by providing a wider margin of debt limit and in lessening the carrying charges, it is nevertheless the more costly method of financing for the taxpayer, according to William H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, from whose paper before the recent meeting of the American Association for the Advancement of Science the following matter has been taken.

THE TAXPAYER AND HIS MONEY

If repaving be paid for out of current taxes and it cost the taxpayer $100 for his share, he would lose the use of this money. If, however, he elected to pay an annual amount equal to the interest and sinking-fund charges to redeem a bond running for a term theoretically equal to the economical life of the pavement, the taxpayer could deposit this $100 in a savings bank. At 4 per cent compound interest it would amount to $219 in 20 years, while the total annual interest and sinking-fund charges, based on the bond-issue method of payment, would amount to only $147 in the same length of time. This would be $72 less than the sum accumulated at compound interest on his original $100, and represents a saving of just that amount.

As all communal governments should be conducted in the interest of the people, it would seem that the cheaper method of financing for the taxpayer is to pay annually the interest and sinking-fund charges on loan funds for the period of the economical life of the pavement. He thus secures the advantage of being able to invest, at compound interest, funds equal in amount to the original cost of the pavement.

PAVEMENTS ONLY PART OF FINANCIAL BURDEN

In discussing the methods of financing pavements, it should be borne in mind that they constitute only a part of the necessary structures or improvements upon which a communal scheme of financing is based. In other words, the terms for which the bonds are sold may be based on the average economical life and proportionate values of all classes of structures. An illustration of this is given in the following quotation from the 1915 report of John M. Walton, comptroller of the city of Philadelphia:

"*Life of City Property*—The question has been raised as to the propriety of including short-lived equipment in the property account, and of buying equipment that will last but a few years out of thirty-year bonds. I believe that your procedure in this regard has been a perfectly safe one in the past and consider that a continuance of such practice is safe so long as the expenditures of loan moneys for improvements that will last considerably in excess of thiry years greatly outweigh, as at present, the inconsiderable expenditures of loan moneys for short-lived equipment. Annual estimated depreciation in 1915 and subsequent years is and will be charged to expense, so that the current revenue of each year will have to bear its fair share of burden for depreciation on property and equipment and the resulting operating deficit or operating surplus will show clearly whether current revenues are sufficient to meet all the expenses of the year, including upkeep and replacement of the city's property and equipment.

"The average life of each dollar's worth of city structures, non-structural improvements and equipment at present is 60.62 years. Taking the property and equipment separately, the average life of each dollar's worth of structures and non-structural improvements is 62.72 years; while the average life of each dollar's worth of equipment is 21.92 years. The fact that the average life of the equipment and property combined is only 2.1 years less than the average life of the structures and non-structural improvements apart from the equipment is owing to the fact that the city, for every dollar that it has invested in its equipment, has $18.50 invested in its structures and non-structural improvements."

CONSIDERATION OF ANNUAL UNIT COST

There are many considerations entering into the determination of a financial policy. It would appear, in a general engineering discussion, that the annual unit cost should be considered as the annual interest and sinking-fund charges on term bonds, or the annual cost on serial bonds to redeem a proportionate amount of the loan each year, extending over a period equivalent to the theoretical economical life of the pavement; to this should be added the annual maintenance costs.

The accompanying table gives a general idea of the first costs of the different types of pavements and their costs per square yard per year. Figures are given for various methods of financing and for various terms of payment.

LIFE OF BASE AND SURFACE CONSIDERED SEPARATELY

The consideration of the mathematical mean economical life of the base and surface courses is desirable in a general discussion of the economical life of pavements and their costs. The figures in column D of the table represent the mathematical mean economical life of each type of pavement based on the estimated economical lives and relative costs of the base and surface courses.

The maintenance cost values and the estimated economical life given in the table are only approximate, are based upon average conditions, and are not intended to represent definite data applicable to any city or locality. The actual maintenance costs of pavements cannot be determined until some of the cost data records now being kept have extended over a period of years equivalent to the economical life of the several types of pavement. In the meantime certain assumptions will have to be made, based upon research and the experience and judgment of highway engineers. It should be borne in mind, however, that a similar procedure was necessary in the infancy of life-insurance companies and other similar undertakings.

That each of these different types of pavements is usually constructed to meet specific traffic conditions should be taken into consideration. For instance, a granite-block pavement on a concrete base, costing $0.1732 per square yard per year, would be constructed for heavy traffic, whereas a bituminous pavement on a broken-stone base costing $0.1569 per square yard per year would be used on a suburban or country road carrying comparatively light traffic. Likewise, concrete and bituminous pavements, while they may show a higher annual cost than waterbound macadam, are adaptable for traffic conditions where waterbound macadam would not be suitable. The following data are given to illustrate the comparative costs of three extensively used types of pavements subjected to similar traffic and other conditions:

Character of pavement	Estimated mathematical mean economical life of base and surface courses	Estimated first cost	Total annual cost
Sheet asphalt	17	$1.90	$0.1862
Wood block	20	3.00	.2507
Granite block	40	3.45	.1851

Annual Costs of Financing Pavements on Loan Funds, Plus Estimated Maintenance Costs

A	B	C	D	E	F	G	H	I	J	K
City Street Pavements										
SHEET ASPHALT:										
6-in. concrete base course	$0.85	40[1]	23	$0.03	$0.2231	$0.1740	$0.1324	$0.1592	$0.1506	$0.1579
1½-in. surface and 1-in. binder courses	1.05	17								
VITRIFIED BLOCK:										
6-in. concrete base course	.85	40	19	.04	.3688	.2851	.2129	.2448	.2325	.2417
4-in. surface and 1-in. sand cushion courses	1.80	15								
GRANITE BLOCK:										
6-in. concrete base course	.85	40	36	.005	.2181	.1603	.1012	.1748	.1555	.1732
5½-in. surface and 1-in. sand cushion courses	2.60[2]	34								
WOOD BLOCK:										
6-in. concrete base course	.85	40	24	.03	.3296	.2534	.1887	.2311	.2150	.2267
4-in. surf. and 1-in. 1:4 cement-mortar cush'n c'rses	2.15	20								
ASPHALT BLOCK:										
6-in. cement concrete base course	.85	40	18	.06	.3755	.2951	.2271	.2544	.2452	.2535
3-in. asphalt block surface and 1-in. 1:4 cement-mortar cushion courses	1.60	14								
BITUMINOUS:										
6-in. concrete base course	.85	40	20	.05	.2574	.2046	.1598	.1828	.1760	.1824
1½-in. surface and 1-in. binder courses	.95	14								
BITUMINOUS:										
6-in. concrete base course	.85	40	17	.05	.2624	.2083	.1625	.1792	.1722	.1774
2-in. surface course	.70	10								
Suburban and Country Roads										
BITUMINOUS:										
5-in. concrete base course	.70	40	26	.03	.1813	.1428	.1102	.1353	.1265	.1332
1½-in. surface and 1-in. binder courses	.95	20								
BITUMINOUS:										
5-in. concrete base course	.70	40	22	.04	.1893	.1514	.1190	.1384	.1316	.1369
2-in. surface course	.70	15								
BITUMINOUS:										
6-inch broken stone base course	.60	20	15	.04	.2456	.1932	.1489	.1588	.1527	.1569
2-in. surface course	.70	12								
BITUMINOUS:										
3-in. broken stone base course	.60	20	14	.04	.2495	.1961	.1510	.1581	.1497	.1536
3-in. penetration surface course	.60	10								
CONCRETE, REINFORCED:										
6-in. concrete course	1.45	20	20	.04	.2087	.1658	.1294	.1467	.1415	.1467
WATERBOUND MACADAM:										
8-in. telford base course	.50	30	15	.06	.2152	.1756	.1421	.1505	.1468	.1499
4-in. broken traprock surface (course bituminous surface treated)	.50	10								
WATERBOUND MACADAM:										
4-in. broken stone course	.50	20	14	.06	.2346	.1901	.1524	.1584	.1514	.1547
4-in. broken traprock surface (course bituminous surface treated)	.50	10								

A. *Character of Pavement*—Only the more extensively used types of constructions have been considered. Each pavement has been subdivided into its two component parts—namely, base course and surface course, for consideration separately with respect to estimated first cost and economical life.

B. *Estimated First Cost*—The indicated values are arbitrarily based upon the approximate average unit prices prevailing during the past several years. Where necessary, due allowances should be made, however, in specific localities and at such times as the current market prices of labor and materials make revisions necessary.

C. *Estimated Economical Life*—The estimated economical life values are based upon the assumed life of the base and surface courses respectively of the different types of pavements under the average traffic conditions for which each specific type is best suited.

D. *Mathematical Mean Economical Life*—The indicated mathematical mean economical life figures are empirical values. They were derived by the following method: If the annual sinking fund charges for the base and surface courses are added together, this sum taken as an annual sinking fund charge will at the end of a certain period of years accumulate an amount equal to that of the total unit cost of the pavement. This period of years, which may be interpolated from a sinking fund table, is considered to be the mathematical mean economical life of the pavement.

E. *Maintenance*—The indicated annual maintenance costs include such repairs as are necessitated by service wear and the application of bituminous surface treatment to waterbound macadam pavements.

F, G, H. *Ten, Thirty and Fifty-Year Bonds*—The costs under term bonds for periods of 10, 30 and 50 years respectively include the sinking-fund charges (based upon the assumption that a sufficient sum be set aside each year and invested to earn 4 per cent compound interest, which fund plus the earned interest will amortize the face value of the bond at its maturity, and the total net amount thus paid into the sinking fund is prorated in equal annual charges over the entire economical life of the base and surface courses respectively), plus the interest on the loan funds (which is the total amount of interest at 4 per cent per annum paid during the term of the loan, prorated in equal annual charges over the entire economical life of the base and surface courses respectively), plus the annual maintenance costs.

I. *Economical Life Bonds*—The costs under economical life bonds include the annual sinking fund and interest charges on two bonds extending for terms equal respectively to estimated economical life of the base and the surface courses, plus the annual maintenance costs.

J. *Serial Bonds*—The costs under serial bonds include the annual proportional part of the original loan fund extending for a period equal to the mathematical mean economical life of the pavement, which is redeemed each year by installment payments, plus the interest on the unpaid balance of the loan fund, plus the annual maintenance costs.

K. *Mathematical Mean Economical Life Bonds*—The costs under mathematical mean economical life bonds include the average annual sinking fund and interest charges on a bond extending for a period equal to the mathematical mean economical life of the base and surface courses, plus the annual maintenance costs.

[1] *Concrete Base Courses*—The economical life of the concrete foundation courses has, in all cases, been based on the assumed necessity of replacement due to its condition caused by openings and other causes.

[2] *Salvage of Old Granite Blocks*—At the expiration of the economical life of the surface course of the granite block pavement, the old blocks have a salvage value of 50 cents a square yard, which value has been prorated over the economical life and is deducted in the indicated annual costs.

[3] *Ten-Year Bonds*—The 10-year bonds, while less costly to the city than bonds running for the estimated economical life of the pavement, are, however, more costly to the taxpayer, as they require a greater outlay each year.

It will be noted from the table that two asphalt pavements may be constructed for less than the cost of a granite-block pavement, but from the standpoint of convenience to business interests and the general public a granite-block pavement may ultimately prove to be the less costly due to the fact that it will be unnecessary to disturb the pavement during its economical life.

There are a number of very heavy traffic streets in the business sections of such cities as New York, Chicago, Philadelphia and Boston, where a sheet asphalt pavement would last not more than seven years, while a granite-block pavement would last seventeen years. The cost data given below are for situations of this character, traffic and other conditions being similar.

The total annual cost of granite-block pavement as indicated in the table below includes a deduction of $0.0294, which represents the salvage value of the old granite blocks at the expiration of the pavement's economical life prorated in annual deductions over the economical life of the pavement.

ANNUAL COST OF CLEANING

The cost of cleaning varies with the type of pavement, and there are many considerations entering into these costs, such as the difficulty of cleaning on account of congestion of traffic, width of street, state of repair of pavements, and in block pavements whether or not they are modern pavements with grouted joints, etc. The average cost of cleaning for all types of pavements, based on the costs of several representative cities, is approximately 10 cents per square yard per year. From this it will be noted that the cost for cleaning is practically double, and in some cases more than three times the annual cost of maintenance repairs.

Character of pavement	Estimated economical life in years of base surface		Estimated first cost of base surface		Maintenance	Interest and sinking fund charges	Total annual cost
Sheet asphalt....	40	7	$0.85	$1.05	$0.06	$0.2178	$0.2778
Granite block...	40	17	.85	2.60	.03	.2566	.2572

In Austin It Pays to Think in Advance

The city of Austin, Minn., has an ordinance imposing a penalty of $50 for opening a pavement for a new water, gas or sewer connection that has to be laid after the pavement is completed. This does not apply to necessary repairs.

Baltimore & Ohio Opens New Coal Pier at Baltimore

Plant Consists of Low Wharf Carrying Moving Belts and Traveling Towers Instead of Usual High Superstructure for Cars

THE NEW coal pier of the Baltimore & Ohio Railroad at Curtis Bay, near Baltimore, has been put into service. Besides having what is believed to be the largest capacity of any coal pier in the world—12,000,000 tons per year or 7000 tons maximum per hour—the plant marks an entirely new departure in coal terminals. Instead of the usual high structure, to which railroad cars are by one means or another elevated, being then emptied into bunkers from which chutes lead to the vessels alongside, this plant consists of a pier with a concrete deck 8 ft. above mean tide, on which the coal is handled by moving belts and traveling towers. One of the advantages claimed for the new design is the overcoming of breakage of the coal.

NEW COAL TERMINAL AT BALTIMORE HAS LITTLE RESEMBLANCE TO OTHERS ALONG ATLANTIC SEABOARD

At the shore end of the pier are two car dumpers, equipped with special movable aprons to ease the fall of the coal and prevent breakage. Each dumper feeds three belts 60 in. wide, with a capacity of 2000 tons per hour and a speed of 500 ft. per minute. Two in each group run out on the pier to the loading tower.. The third of the group runs to what is known as the balancing bin.

LOADING AND TRIMMING TOWERS

For each dumper there are two loading towers and a trimming tower. Each loading tower is equipped with a cage supporting a shuttle ram. The cage is raised or lowered to suit the height of the vessel being loaded, thus providing further precaution against breakage of the coal. The cage has a variation of height of 27 ft., the minimum height above the water being 15 ft. The shuttle ram, which can be run out on either side of the pier, has a maximum reach of 45 ft. With the towers traveling along the pier in a horizontal direction and the shuttle working in and out at right angles, this apparatus will load a hatch uniformly and reduce trimming to a minimum.

The two trimming towers, located on either side of the pier, have belts 48 in. wide, with a capacity of 1500 tons per hour when traveling at a speed of 500 ft. per minute. Coal for them is taken from the balancing bin. The towers have swinging booms 45 ft. long. They are attached at their base to turntables and can be moved in a circle on a horizontal plane. They have a vertical variation of 35 deg. each way from the horizontal.

While the loading towers are working on the cargo, the trimming towers are loading the bunker coal. After the loading towers have finished their work, the trimming tower finishes the slow work of the vessel, thereby releasing the loading towers to work on another vessel.

In running the pier at maximum capacity, the operation of the car dumpers must not be interrupted; hence when it becomes necessary to stop a loading tower to shift it to another hatch the coal is placed temporarily in the balancing bin. From there it is taken by either a loading tower or a trimming tower and placed in the vessel.

ELECTRIC CONTROL

The functions of the pier are interlocked and controlled electrically with push buttons located every 20 ft. on each belt-conveyor runway. By pushing a button all movable parts of the belt, tower and feeders are stopped. The operators are located in houses on the shuttles. They first start the shuttle belt, and when this is running at full speed the main belts automatically start, and when at full speed the feeders also start automatically.

The shuttle belt is run at a greater speed than the main belt, the main belt running faster than the feeders, so that there is no danger of flooding the main or shuttle belt. A master control of the pier is located in the superintendent's office, enabling him to establish the maximum speed at which the belts are to run.

The pier, which was begun in February, 1916, cost $2,500,000. It was the conception of M. A. Long, architect and assistant to the chief engineer for the Baltimore & Ohio Railroad, and was carried out under the direction of Francis Lee Stuart and R. N. Begien, former and present chief engineer respectively.

Some Ethical Questions Answered

Actual or Hypothetical Situations Are Treated by Special Committee of American Institute of Consulting Engineers

THE American Institute of Consulting Engineers has established a custom, similar to that of the Bar Association, of answering ethical questions presented to it, based upon facts coming under the notice or practice of engineers, or upon hypothetical situations. The questions are handled by a special committee intrusted with this work, and upon adoption by the council it is ordered that those of particular materiality be printed and published for the benefit of the profession generally.

The first series of these questions, together with the approved answers, have just been issued and are here given in a condensed form. Additional cases will be published from time to time as occasion seems to warrant.

1. *Question*—Is it proper or wise on the part of A to accept responsibility without personally investigating or verifying the accuracy or adequacy of surveys and data supplied by B?

Answer—It would be unwise for A to proceed without personally satisfying himself of the adequacy and accuracy of the data supplied by B, unless it were distinctly understood or stated in the terms of A's engagement that he should assume no responsibility for the correctness of the data supplied to him. Such review and verification is desirable in order to protect both the client and the engineer from the consequences of erroneous data or misunderstood conditions.

2. *Question*—Would it be unethical for an engineer to accept and act on the proposition of a patent attorney to solicit or turn over legal work to him on a fee-sharing basis?

Answer—The sharing of fees or profits as compensation for soliciting engagements is regarded among engineers as unethical. This does not apply to the division of fees in cases where two or more engineers are jointly employed or engaged upon the same work.

USE OF NAMES AS REFERENCES

3. *Question*—Is it unethical for engineers to permit the use of their names as references in business enterprises, or for the promotion of business schemes?

Answer—It is regarded as at least imprudent for an engineer to permit the use of his name as a reference regarding the character and responsibility of persons or business concerns for advertising purposes. The practice might lead not only to personal embarrassment but to the discredit of the profession.

4. *Question*—Is an engineer entitled to claim and receive the whole amount of the fee which would be due him if work suspended for good reason had gone on to completion?

Answer—Such contingencies should be provided for in the original agreement between engineer and client. In the absence of such a provision, and unless the circumstances should warrant a different action, and particularly where the abandonment occurs through no fault or bad faith on the part of the client, settlement upon an equitable basis for the work already done, and the expenses and obligations already incurred, would be fair and just to both parties.

PUBLIC COMPETITIONS

5. *Question*—Should engineers recognize or take part in such public competitions for services where it is to be presumed that the lowest bidder will be engaged for the services?

Answer—It is not regarded as ethical for reputable engineers to enter such competitions. This does not, however, apply to competitions for designs for a specific structure where such competition is properly conducted and provision is made for reasonable compensation for rejected designs.

6. *Question*—If in the course of an investigation an engineer makes discoveries which, while foreign to the subject of his specific engagement, are so related to the business of the client as to be of great importance to him and, if disclosed, might seriously affect that business, does the present ethical relation of the engineer to his former client permit him to develop these discoveries for his personal use or profit, or to publish an account of them in the interest of science?

Answer—The engineer should not make use of information or discoveries, or the results therefrom, obtained while in the service of a client, in any manner adverse to the interests of the client.

Nomographic Chart Simplifies Column Design

Values for Required Area, Length Ratio and Average Unit Stress Easily Obtained When Length and Radius of Gyration Are Known

By CHARLES D. CONKLIN, JR.
Cooper Union, New York City

SUPPLEMENTING the articles describing methods of constructing nomographic charts and examples of their application in the Engineering Record of June 26, 1915, pages 807 and 809, there is here given a chart which will aid the structural designer in selecting sections for columns required to carry a given load, or to find the safe load of a given column, according to the well-known straight-line formula $S = 16{,}000 - 70L/R$. The chart is particularly useful in cases where numerous column sizes are required, the load and length of each being known.

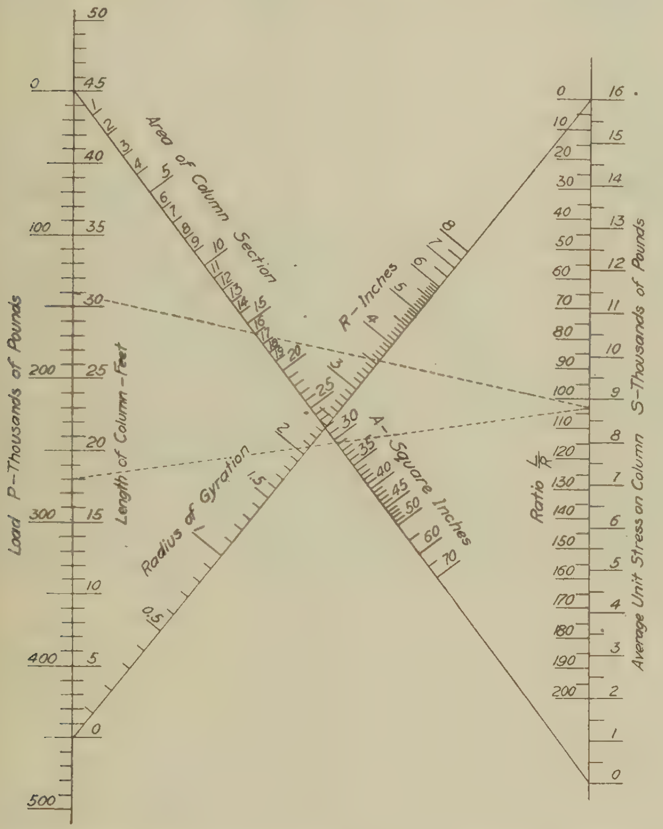


CHART SIMPLIFIES SOLUTION OF A. R. E. A. COLUMN FORMULA

DIRECTIONS FOR USE—APPLICATION TO PROBLEM

Given the load, length and any assumed radius of gyration, the slenderness ratio L/R, the average allowable unit stress S, and the required area A can be determined by two moves of a triangle or other straight edge. An example will indicate the procedure, as illustrated by the dotted lines on the diagram.

For a column to carry 140,000 lb., 18 ft. long, least radius of gyration 2.1, place a straight edge at 18 on the inner side of the left vertical scale and at 2.1 on the inclined scale for R. The slenderness ratio is then read as 103 on the inside of the right vertical scale, the straight edge is swung around this point to an intersection with 140,000 on the outside of the left vertical scale, and the desired value of 16 sq. in for the area A is read on the other inclined scale. If desired, the average unit stress is easily read as 8800 lb. per square inch on the outside of the right vertical scale.

If it be desired to investigate a given column of known area and properties, the procedure is the same except that the second line connects with the known area A and gives the desired allowable total load P on the outside of the left vertical scale. Any other straight-line column formula can readily be charted in a similar manner.

Largest Reclamation Pumping Plant in Country Constructed

Pumps Designed to Meet River-Flood Conditions in Solving California Problem—Six 800 Horsepower Units Required

THE LARGEST reclamation pumping plant in this country, requiring six 800-hp. motors, each driving a 50-in. centrifugal pump, has been recently constructed in California. Each pump has a normal capacity of 175 sec.-ft. against a discharge head of 29 ft. The design of this plant, including the method used in estimating the amount of drainage water and the resultant plant capacity, is described in a paper entitled "The Design and Test of a Large Reclamation Pumping Plant," recently presented by G. C. Noble before the American Society of Mechanical Engineers.

DISTRICT SUBJECTED TO FLOODS

The reclamation district, known as Sutter Basin, is located in the Sacramento Valley, at the junction of the Sacramento and Feather rivers, and is so situated that it is subjected to the flood waters of both. An extreme length of approximately 19 miles and a maximum width of 10 miles give an area of approximately 66,000 acres. The lowest point, which is located near the center of the basin, has an elevation of 10 ft. above datum, while the maximum elevation is 30 ft. above. In winter, with a maximum flood elevation of 39 ft. above datum, the entire district is submerged to a possible depth of 20 ft. To cope with these flood conditions a levee, 70 miles long, was designed for the entire circumference. As the natural drainage is toward an existing slough, emptying into the Sacramento River near its junction with the Feather, the pumping plant was located at a point where this slough was to be crossed by the levees.

SOURCES AND QUANTITY OF DRAINAGE WATER

The method of estimating the amount of drainage water was described as follows: In a project of this kind the drainage water is made up of runoff from rainfall, and seepage either through the levees or through other underground channels. Although there are certain features, such as rate of rainfall, duration of rain, state of land cultivation, etc., which are not subject to precise determination, still the quantity of drainage water occurring at the pumping plant can be determined with sufficient accuracy to provide for maximum pump capacity. On the other hand, an accurate estimated flow of seepage may not be as readily determined; but this flow is unnecessary in the design of pump capacity, as the quantity of seepage at any time, estimated at ½ to 1½ sec.-ft. per mile of levee, is slight as compared with the maximum drainage from rainfall.

Previous to the investigation there had been no observation of rainfall within the district. However, there were nearby recording stations, from the readings of which an analysis of the estimated rainfall was made and the maximum period of rainfall determined.

HOURLY RUNOFF

The hourly runoff, due to hourly rainfall, Mr. Noble points out, is that which determines the required capacity of the pumps in a problem of this nature. It varies with many conditions, among which are the rate and duration of rain. It is not as readily approximated as the yearly runoff, which may be determined very accurately from the yearly rainfall, and therefore it becomes necessary to assign to the maximum recorded rainfall a given hourly rate. Grunsky's method of estimating the hourly rate of rainfall was accordingly adopted with some modification. This method assumes that 50 per cent more rain falls in any one period than in the preceding period. It was further assumed that the rainfall rate for any one day was a minimum at the beginning, increasing at the above 1 to 1½ ratio to a maximum which lasted for three hours during the middle of the day and then decreased to a minimum at the end of 24 hours in a 1½ to 1 ratio. An average rainfall rate of 1½ in. per day was adopted.

RUNOFF ESTIMATED AT 25 PER CENT

It was estimated that 25 per cent of the rainfall would arrive at the pumping plant in the form of runoff, this varying with the rate of rainfall, being greatest with the greatest rate. With equal rates and at intervals equidistant from the peak, it was assumed greater during the latter part of the day than earlier.

Previously in the district there had been laid out a system of drainage ditches, so designed as to carry the water at a certain velocity. It was therefore assured that the ditches were equally effective as far as the delivery of water to the pumping plant was concerned. The reclamation district was accordingly divided into various runoff zones, so selected that from each successive unit water would require one more hour to reach the plant. The time required for the rainfall to reach the ditches was assumed the same for each zone and was therefore omitted in the calculations.

DESIGN OF PUMPING PLANT

In designing the pumps, the suction was extended to a point 10 ft. above datum. It was assumed that without serious flooding water could rise to a point 20 ft. above datum, which would give a storage capacity of approximately 1150 acre-feet and necessitate a pump capacity of 1000 to 1100 sec.-ft.

The pumping head was designed to meet maximum conditions. Generally the peak of flood waters occurred from one to three days after the rainfall, but since conditions might cause the peak to arrive simultaneously with the maximum runoff discharge it was decided to provide pump capacity correspondingly large in order to meet this possible maximum head. Prior to the construction of the levee, a maximum flood height of 39.2 ft. above datum had been recorded. After investigating conditions governing the maximum head, which would occur after the levee had been constructed and the water excluded from the overflow district, it was decided to make the discharge water level 42 ft. above datum. This investigation was also necessary for determining a safe height for the levee.

An elevation of the water surface in the suction sump was taken as 16 ft., thus giving a maximum static head of 26 ft. With an estimated friction loss in the discharge pipes of 3 ft., a total maximum pumping head of 29 ft. was obtained. Pumps were therefore selected to handle 1000 sec.-ft. against a 29-ft. head.

Electric-motor-driven centrifugal pumps were chosen, the selection being influenced by the fact that there were three power companies within a reasonable distance. It was also thought that the advantage of lower initial cost greatly offsets a slightly higher operating expense. The pumps were designed for six units, each being 50 in. and having a normal capacity 175 sec.-ft. against a discharge head of 29 ft. Each unit is to be driven by an 800-hp. electric one-speed motor.

PLANT OF MINIMUM CAPACITY

A plant of minimum capacity was designed on account of the construction problems. Each pumping unit is independent of the remainder and has a separate steel suction pipe. The discharge pipes from each of two units is brought into a single reinforced-concrete pipe, 78 in. in diameter, which in turn passes through the levee into a valve chamber. Here are inserted a large wood and steel swinging check valve and a sluice gate. No valves appear on the suction, but on each discharge there is located, just outside the building, a 50-in. gate valve. These valves are operated by a direct-current motor located within the building and connected by a shaft passing through a stuffing box in the wall. A switchboard placed at one end of the building operates all valves and motors.

Priming pumps of the wet vacuum type, capable of priming one pump in 10 minutes, were installed in duplicate. For operating the gate valve motors, a storage battery was designed, so as to replace the main source of supply in case of failure. Electric power is delivered to the motors at 2220 volts from three 1500-kva. outdoor-type, oil cooled transformers (60,000-22,000-volts) mounted on a platform.

The total cost of the plant, exclusive of engineering, was approximately $170,000, of which the building, discharge pipes and sump represent $75,000, and the pumping machinery $95,000. It was estimated that power consumption for the pumping runoff only would be 700,000 to 1,200,000 kw.-hr.

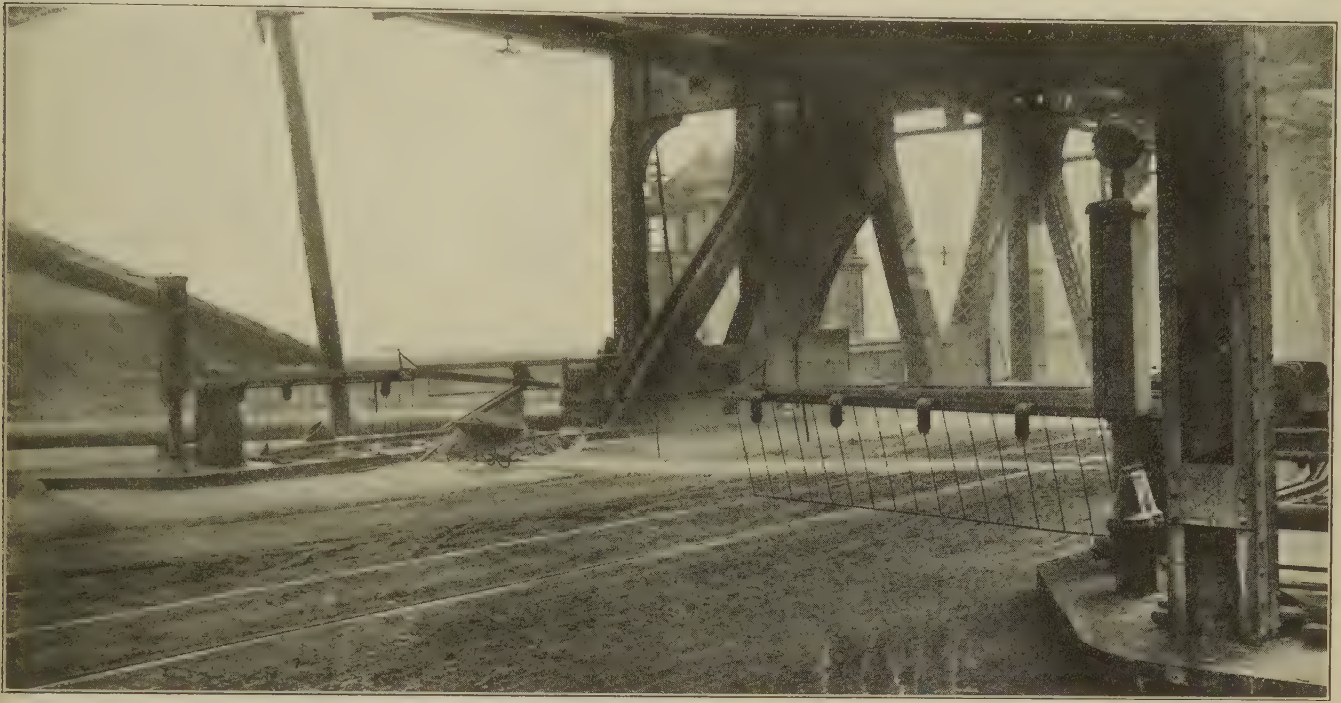
TESTS

The electrical input to the motor was measured by means of two indicating wattmeters. The discharge head on the pump was obtained by means of a U-tube of water, the total pumping head being taken as the difference in the level between the water in the sump and height of water shown in the U-tube. The amount of water was obtained by means of a Cole and Flad pitometer. Only a preliminary test on one unit had been made at the time of presentation of the article, so that accurate results could not be given.

Chicago Has Problem to Protect Street Traffic at Drawbridges

New Devices, Installed to Prevent Pedestrians and Automobiles from Plunging Into River, Include Flashing Signals on Gates and Cushion Barriers

By F. H. AVERY
Engineer in Charge of Bridge Repairs, Chicago



FOUR RED LIGHTS PLACED ON EACH ARM FLASH ALTERNATELY, GIVING AN IMPRESSION OF A WAVING SIGNAL

RECENT DESIGNS in stop signals, barrier gates and derails for city drawbridges, some of which have already been installed at Chicago, have in view the protection not only of the pedestrian but of the automobile, motor truck and the electric railway car as well, even to the extent of coping with careless driving. The most recent installation, that of a barrier gate, is designed to stop a 4000-lb. machine traveling 30 miles per hour.

When a crossing policeman blows his whistle on a downtown corner, the public obeys instantly and stops, but when a bridge bell rings, the traffic makes a frantic attempt to cross the bridge before it opens. The engineer must recognize this fact and make his first effort along the line of teaching the public what to do when the bell rings. In all countries and times the ringing of a bell has been an alarm signal, and there is no doubt that the sudden ringing of a bell still raises a feeling of alarm and terror. This may easily account for the unnecessary and undesirable stampede of the traffic.

STANDARDIZATION OF STOP SIGNALS A HELP

The object of this article is to call public attention to the danger at bridges and also to decrease the danger by standardizing stop signs and educating the public to them. It is evident that gates are necessary and must have aprons so that people cannot crawl under or around them when they are lowered; also that any system of stop signals must be preceded by a long and systematic campaign of education before the signals will do much good, as the public is not trained to observe signals.

SIMILARITY OF FIXED AND MOVABLE STRUCTURES CAUSE OF CONFUSION

One source of trouble is the fact that when a draw-span occurs near the center of a long viaduct with through trusses, a driver cannot tell at night or in rainy weather when he is approaching the draw, because of the similarity in the fixed and movable structures. Several cases have occurred where machines have climbed a bascule leaf after it has started up. It is evident, then, that the stop sign must be very compelling in its effect on the public and of such a nature that people not used to it or not knowing where to look for it will see it instantly when it is displayed.

If signals were standardized all over the country, the drivers would know a stop sign when they saw one. All automobile magazines and clubs should aid in this, and it must be impressed on the driver that "Stop" means cease moving.

In Chicago a hand bell is rung as a warning to the traffic to clear the span so that it can be opened. Then a jingler or vibrating electric bell is rung, two electric lighted stop signs are started on each approach and finally the gates are lowered before the span is opened. This should cause the oncoming traffic to stop, so that the only time lost is that required for the traffic to pass over the span, generally about 1½ minutes.

EARLY STOP SIGNS

The first stop signs were composed of a sheet-metal box with red glass front reading "Stop" vertically and lighted by two rows of five lights each, that burned in series. Two rows of lights were used, so that if the carbon filament in a lamp broke, the signal would not fail. This signal took care of team traffic fairly well, but as it stood close to the curb, overhanging coal wagons broke it, or teams stopping in front of it completely hid it from view. As soon as the fast-moving auto came into general use, the signal was outgrown, for frequently the driver of an auto running around a team failed to see the box, while the noise of the engine drowned that of the jingler.

The next signal tried was the so-called wigwag, consisting of a red disk that swings back and forth and which has a red light at the center. The disk is marked "Bridge Danger," while on the post is a sign that reads "Danger," in red letters. At first the autos stopped, particularly at night, but as soon as the drivers became familiar with the new signal they sped ahead on seeing the wigwag begin to move. This is a good signal to guard a railroad crossing, but is nearly useless on a congested city span, because it stands too high. The signal did, however, show that no signal so far offered was satisfactory.

FLASHING SIGNAL PLACED ON GATES

The writer evolved the idea of placing the signal on the gate itself, where it could be seen at any distance or position, and where, best of all, the driver could not run by it without running over it. The actual working out of the details of the first signal of this type was done by Mr. Harrington of the City Bridge Division.

The present stop sign is substantially made of cast iron and placed so that it cannot be knocked down, and the new type shortly to be installed will have the shape of ornamental pylons, in accordance with the city-beautiful idea. Four red lights placed on each arm are so arranged by means of a flasher that one stop light burns "Stop" at the curb and then the signal runs across the gates and the opposite stop sign lights up, after which the procedure is reversed, thus giving the impression of a waving signal.

That putting the signal out on the arms has had a wonderful effect in decreasing gate breakages is shown by the fact that the arms on Lake Street Bridge, where the first signal of this type was installed, have not been broken since the installation, while in the same length of time the unlighted Rush Street arms have been broken so often that in some cases the gates have not been operated for a month at a time.

HIGH VISIBILITY OF NEW SIGNALS

At night the visibility of the new signal is vastly superior to anything that has been produced up to date, due to the fact that, extending as it does from curb to curb, it cannot be hidden by traffic. The lights begin to flash while the arms are in the up position, thus still further increasing the visibility, for the driver sees the motion of the down-coming gate outlined for him by the flashing lights. Multiplying the number of signals that convey the same warning is wrong in principle, but certainly experience has proved that both a visible and an audible signal must be used, and also that the gates must be made so that they cannot be passed by anything larger than a dog.

NECESSARY FEATURES IN GATE DESIGN

The gate, to be any protection, must have an apron on it so that no one can crawl under it, and must extend from handrail to handrail so that no one can walk around it.

The first gates were air-operated and could not be reversed quickly once they were started down. This was one of the main troubles. The bridgetender's chance of preventing a broken gate was almost none, for he could not reverse the gate in time. The air gate could not be operated at all by the bridgetender in the case of a drawspan.

The electrically operated gate avoided these two serious faults. Instead of having trolley wires at the spider casting, contactors were placed at the ends of the center truss. These consisted of wheel contacts that wiped against copper strips placed on the abutment. This worked out very well, for after the bridgetender had lowered his gates and made his swing, he reversed his switches while waiting for the boat to pass, then as soon as the bridge was centered again on the abutments the gates all rose automatically from the action of the contactors.

PROTECTION OF GATE AGAINST WRECKING

The present gate arm is provided with a hinge and wooden pin at the curb line, so that when hit the pin shears off and allows the arm to swing around without breaking. The gate post is set back at the handrail of the sidewalk, thus avoiding the use of sidewalk arms, although of course it lengthens the street arms. If the post cannot be set back in this manner, a heavy pipe is set in concrete in such a way as to protect the gate by wrecking anything that runs into the pipe.

The swing and vertical-lift bridges need the gates more than the bascule type, since the latter block the roadway once they are up. This distinction at once brings out the question, If the gates are placed at a swingspan, why not have them of such a nature as really to stop traffic? In many of the drawbridge accidents a very small resistance would catch a machine and stop it entirely. There are numerous devices of this kind patented but not in service.

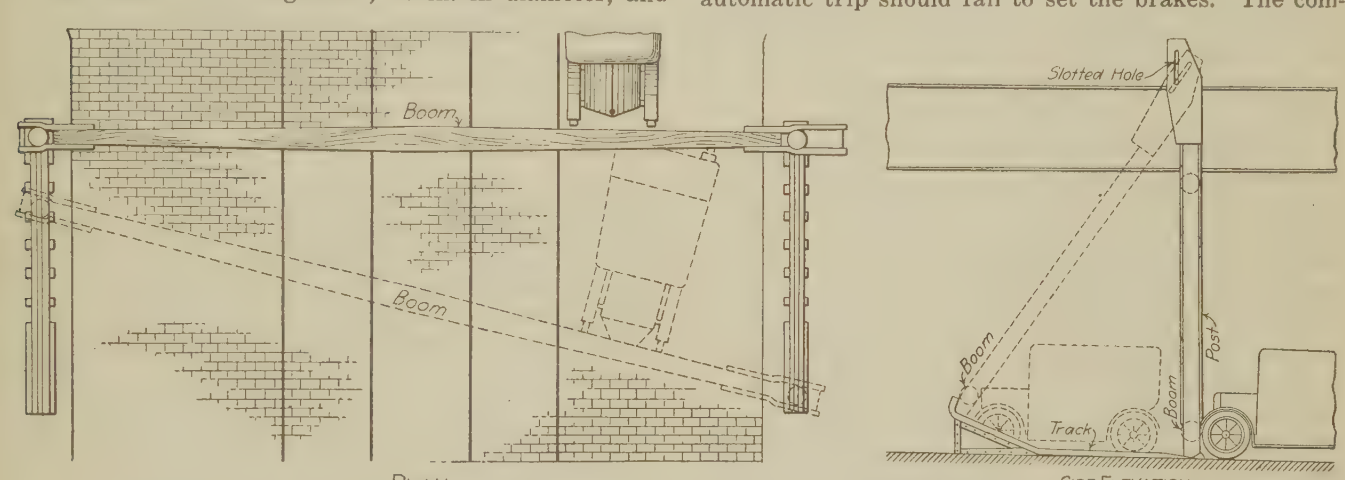
THREE ESSENTIALS OF ELECTRIC GATE

There are three essential points in a good electric gate: The machinery portion of the post must be accessible for repairs with the gate in the open position; the gate must absolutely lock both in the open position so that the wind cannot blow it partly down and also in the down position so that it cannot be thrown up, and it must have a hand-operating device by which it can be raised to the clear position in case of electric trouble. Furthermore, the parts must be free from eccentricity and lost motion, so that the arms cannot lash back and forth, and there should be no landing rod to stop the gate in the closed position, as this breaks the filaments of the signal lights. The gate mechanism must be simply and ruggedly made and the electric switch or cut-out free from arcing trouble.

CUSHION-BARRIER GATE, LATEST DESIGN

The writer has designed and is installing at the Lake Street Bridge a cushion-barrier gate. It consists of a boom which travels vertically on two posts at the curb line, the posts being free to swing at the top and slide at the bottom. When the boom is struck by a machine, the post rolls backward about a foot on a wheel placed at the bottom of the post. The motion then changes from rolling to sliding by means of a track which picks the post up on two bearings outside of the wheel. The post slides horizontally for 10 ft. and then climbs at an angle of about 45 deg. for 5 ft. more. To provide for the lengthening of the post which this motion requires, the support at the top on which the post turns has a slotted hole.

The boom is of Douglas fir, 16 in. in diameter, and has forked ends, so that when struck by a machine close to the curb the post on that side can start independent of the opposite one, and the lengthening of the boom, which this requires, is given by the forked end, made of 3 x 4 x ½-in. angles.



PLAN SIDE ELEVATION

STOPS A 4000-POUND MACHINE RUNNING 30 MILES PER HOUR WITHOUT INJURY TO PASSENGERS

The arm weighs 1000 lb., and the two posts with counterweights 3000 lb., making a total of 4000 lb. which must be put in motion when struck by a machine. The boom can spring 18 in. without breaking, and the tires furnish additional cushion, so that the rolling motion should take place without damage. The resistance then increases, with the change to sliding friction, and the stopping action is still further increased when it becomes necessary to lift the boom and posts a distance of 2 ft. vertically in the last 5 ft. of travel. There would still be left the 18-in. deflection in the boom. The gate is designed to stop a 4000-lb. machine going 30 miles per hour, without injury to its occupants.

MOVABLE SWITCH FOR PASSING TROLLEY WIRES

The trolley wires must be passed, and this is accomplished by a switch that is operated by the motion of the boom. The movable portion of the switch is not dead at any time, and so a car cannot get stalled in case it stops with the trolley on the switch.

The boom is fastened to the counterweights at each end by two cables, so that the breaking of one would not drop the boom on the traffic below. The cushion gate is just back of the electric gates, which are lowered first, after which the barrier comes down. The boom is so heavy that a machine cannot throw it high enough to hit the wind shield. It is also designed to withstand a street car. However, a heavily loaded truck would tax it severely.

This gate will be tested as soon as it is installed by running into it with an auto truck. It is hoped that the device will prove successful. It has no springs, cylinders or brake wheels to get out of adjustment.

The gate must be free from clogging by ice, sleet or street dirt. To cope with motor trouble it must be so constructed that the bridgetender can raise it by hand if the motor gives out, or so that if damaged by a machine he can clear the street for traffic.

A gate of this nature could be designed of sufficient strength to stop even an elevated train in case the automatic trip should fail to set the brakes. The comparatively light automobile should be stopped without trouble unless the speed is excessive.

A rigid gate has been installed at the Halsted lift bridge which follows the bridge up and displays a stop sign in red electric lights. It is much better than no gate, and if the driver all but stopped this gate would complete the stop for him. A rigid gate would be much cheaper than a cushion-barrier gate, but the gate should prevent loss of life or injury if possible, and not instantly stop a machine going 25 miles an hour.

DERAILS PREVENT ACCIDENTS TO CARS

Street cars on a swing or vertical-lift span should be protected by a derail operated by the bridgetender and interlocked so that the span cannot be opened unless the derail is open. Where the approach has a steep up grade to the span there is not much need for a derail, for even if the brakes refused to work the speed of the car would be checked by the up grade so that there would be little chance of its leaping over the abutment. Where the approach is level or on a down grade to the span, however, a derail is necessary. The city now operates seven swingbridges, three of which are already protected on one approach by a derail, and derails are now to be installed at all swingspans.

The Clark Street derail is interlocked with the end lock of the span so that the operator cannot pull out the end lock until the solenoid located in the operator's house raises the dog on the push rod of the end lock. This solenoid is energized by the electrical switch, located at the curb opposite the derail, when the derail is open. This makes sure that the bridge end lock is released only when the derail actually opens, as otherwise the operator, not being able to see the derail or its target, might throw the derail lever and, because of a broken rod, proceed to open the span with the derail untouched.

The dog on the center lock is under a glass cover, allowing the operator to break the glass and raise the dog by hand in an emergency. He must then report the derail out of order. Such emergency repairs are made at any time during the day or night.

TROUBLE AT ABUTMENT

The most troublesome point in the pipe line of such a derail is at the abutment. It is hoped to overcome some of the difficulties by using at this point a spring which maintains a constant pressure of about 300 lb. against the casting on the end of the push rod at the end floorbeam of the span. This will take care of expansion and does not require the unlatching or unhooking of the pipe line at the abutment when a swing is made. If the operator closes the derail while his span is open, it means breaking off the castings at the abutment spring box. This is prevented by the bar between the end lock and derail levers in the operator's house, which is cross-connected to the derail lever, so that when the end lock is pulled after pulling the derail the derail cannot be pushed back again until the end lock is pushed back.

One bad feature about using the end lock to furnish the interlock is the bridgetender's habit of stopping the span with the end lock by leaving it in the locked position when shutting his span. Where the end lock is a straight in-and-out motion parallel to the center line of bridge the operator cannot stop his span by means of the lock.

A signal should be so wired that it interlocks with the controller to the bridge motors. Every span in Chicago is so wired that the bridgetender has to push in his jingler and stop-sign switch before he can get current to his controller to operate the main motors. However, if the signal fails to work, the operator can still get current, for if this were not the case the bridge might be struck by a vessel and destroyed, or if it occurred while the span were open it might delay emergency traffic.

CHANNEL LIGHT ADOPTED BY CHICAGO

Although channel lights do not affect street traffic, they are certainly stop signs for street traffic, and it may not be amiss to explain the type of light adopted at Chicago. After experimenting with mercury contacts, and pendulum types swinging back of colored glass, the writer designed the present double light hung on a pipe and changed from red to green by a switch located in the head at the top of the light. This switch has no springs and is operated solely by gravity. As the span rises, the light hanging vertically pushes the jaw of the switch around by means of a cam fastened to the bridge.

This light has proved a great success and has never given a false signal. The lamps can be rotated on the pipe in case a bridge crosses the channel at an angle. The lamp has a hand line attached to the bottom and to the bridge handrail, and can be swung up 180 deg. and cleaned. In the same manner the abutment lights, wherever possible, are hung on long pipes turning in a socket.

Ample arrangements must be made for oiling a pendulum light to prevent rusting. These lights are oiled from a pipe reaching up above the top cover of the casting covering the switch mechanism. The bulb of the electric light must be provided with a good spring socket, as no filament made will withstand the constant jarring of traffic. Each set of two swinging lights and each set of two pier lights has a telltale light burning in a box in the bridgetender's house, so that he can always tell at a glance whether his lights are burning.

The guards at a bridge should not be policemen, but they should be in uniform and wear a shield. Such guards would be under the same authority as the bridgetenders and work more in accord with them.

Chicago now provides a house for the bridgetenders, with furnace heat, toilet, washbasin and towel service and telephone. They work in eight-hour shifts. The changed conditions have more than paid expenses. A better class of men has been attracted to the service, which has resulted in reducing damages due to operation.

COST OF EQUIPPING A BRIDGE.

Gates and Stop Signs	
4 gate posts at $200	$800
4 stop signs at $70	280
4 gate controllers at $35	140
2 flashers at $75	150
2 vibrating bells, at $20	40
8 light sockets at $2.50	20
Total material	$1,430
Installation, 75 days, at $6	450
	$1,880
Emergency Lights	
2 emergency lights at $5	$10
2 resistance plates at $10	20
Total material	$30
Installation, 10 days at $6	60
	$90
Channel Lights	
4 swinging lights at $37.50	$150
4 pier lights at $7.50	30
Total material	$180
Installation, 25 days, at $6	150
	$330
Or a total of	$2,300

The bridgetender is required to inspect his bridge when coming on watch and make a test swing once a day in winter to be sure he can open his span for an unexpected trip of the fireboat. He must clean and inspect all his signals, including the channel lights on the span and abutments.

A complete set of signals for one trunnion-type bridge can be installed for about the figures shown in the accompanying table. When the total shown there is multiplied by 46, it gives more than $100,000 to equip Chicago's bridges with modern signals, and this is now being done as rapidly as funds will permit.

This work is being installed under the direction of Thomas G. Pihlfeldt, city bridge engineer, and John Ericson, city engineer.

Fluctuations in Prices Make Changes in Design Desirable

Disproportionate Rise of Steel Argues for More Concrete—Wood Often Desirable—Prices of Capital and Labor Pertinent

By P. R. ELFSTROM
Assistant Engineer, Chicago, Milwaukee & St. Paul Railway, Chicago

ENGINEERS who are not actively engaged in the design and estimating of engineering structures are at present somewhat bewildered by some of the seeming departures from economical and standard practice which are being made by designers during these days of skylarking prices. They have developed by experience a sense of proportion for structures which needs revision in many cases. This is not due to the simple advance in prices but to the disproportionate advance in the different classes of materials. For example, the five main items which an engineer has to deal with have increased about as follows in the three-year period ended Jan. 1, 1917: Steel, 100 to 120 per cent; concrete, 30 to 40 per cent; wood, 20 to 30 per cent; labor, 25 to 40 per cent, and capital, 35 to 45 per cent.

MORE CONCRETE, LESS STEEL

The first thing which the foregoing comparison indicates is the necessity of revising the proportion of steel, concrete and wood required for any one structure. The economical design of 1917 allows a considerable increase in the quantity of concrete in order to reduce the amount of steel which, in 1914, would have proved economical. As an illustration of this the following case is assumed: A railroad bridge is to be constructed across a narrow creek channel about 150 ft. wide and 70 ft. from rail to ground at the center of the ravine. In 1914 a large per cent of engineers acquainted with bridges would have recommended that for permanent work a 150-ft. through truss on concrete abutments would be the most economical design. This very probably would have proved to be the case.

At the present prices, however, the illustration shows that it would be more economical to construct three 50-ft. deck-girder spans on heavy piers. This scheme reduces the amount of steel by 174,000 lb., or about 60 per cent, and increases the concrete masonry by 800 cu. yd., or about 120 per cent. This per cent of change in the proportion of steel to concrete is probably much more than would appear in most designs, but it illustrates the importance of the question.

DUPLICATION DISCONTINUED

Another item in connection with the design of steel work at present is the discontinuance of duplication to a certain degree. Cases are numerous where, in 1914, it would have been economical to duplicate, as the extra steel paid for would have been cheaper than the drafting-room and shop expense. At present, extra drawing and shopwork are being done to save steel on account of the excessive cost of the extra material.

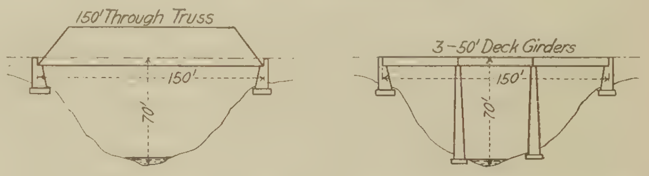
The item of repairing and strengthening old steelwork is now much more important than in 1914. Steelwork which in 1914 was considered to have outlived its usefulness can now be repaired and strengthened with great economy, and fortunate indeed is the corporation or individual with a large second-hand stock of steel on hand. Reconstruction costing more than the original steelwork will often be found economical.

POSSIBLE SAVINGS IN CONCRETE

While the increase in cost of concrete has not kept pace with that of steel, it has made a considerable advance. The difference is large enough to permit the substitution of a reinforced-concrete design for the steel design in a great many structures where the two are in competition.

The increase in cost of concrete is due largely to the advance in materials, and these have also advanced unequally. Reinforcing bars and cement head the list, and any change in design which will save money on these two items without undue increase in the remainder will be found economical.

COMPARISON OF COST AS OF 1914 AND 1917 RESPECTIVELY OF TWO TYPES OF STEEL BRIDGES



150-FOOT THROUGH TRUSS THREE 50-FOOT DECK GIRDERS

150-FOOT THROUGH TRUSS		THREE 50-FOOT DECK GIRDERS	
1914		1914	
Steel 3 cents per lb.		Steel 3 cents per lb.	
Concrete $9 per cu. yd.		Concrete $9 per cu. yd.	
Steel, 294,000 lb.	$8,820	Steel, 120,000 lb.	$3,600
Concrete, 650 cu. yd.	5,850	Concrete, 1450 cu. yd.	13,050
Total	$14,670	Total	$16,650
Annual charges	$1,040	Annual charges	$1,080
1917		1917	
Steel 6 cents per lb.		Steel 6 cents per lb.	
Concrete $12 per cu. yd.		Concrete $12 per cu. yd.	
Steel, 294,000 lb.	$17,640	Steel, 120,000 lb.	$7,200
Concrete, 650 cu. yd.	7,800	Concrete, 1450 cu. yd.	17,400
Total	$25,440	Total	$24,600
Annual charges	$2,134	Annual charges	$1,866

Steel and cement can both be saved by the adoption of more of a mass design for certain structures, the use of a leaner mixture and the elimination of reinforcement to a certain extent. Take, for example, the case of concrete reinforced 1 per cent. This gives about 130 lb. of steel per cubic yard of concrete, which at 4 cents per pound equals $5.20. Adding labor to bend and place this at $2 per cubic yard makes a total of $7.20 that can be saved per cubic yard in case reinforcement can be eliminated. If the mixture could then be made 1:3:6 instead of 1:2:4 about 90 cents would be saved in cement. Assuming that plain concrete can be poured for $12 per cubic yard, it is easily seen that the yardage of a structure can be increased up to 65 per cent over and above the reinforced design and still be the more economical of the two. Large corporations working from standard plans adopted prior to 1914 can well afford to look into the matter of revising them for use under the present scale of prices.

Wood has made a less proportional advance in the last three years than either concrete or steel. Although the life of a wood structure is comparatively short, the low original cost will often make the annual charges or the sum of annual depreciation, annual maintenance and annual interest on money invested less than the annual charges on a more permanent structure.

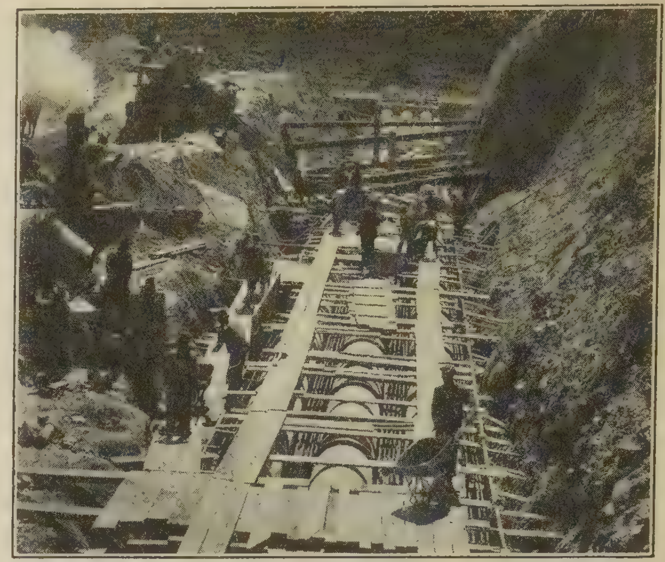
For example, the bridge used in the foregoing illustration could be assumed to replace a timber trestle. The annual charges to renew this in kind in 1914 would probably have been around $1200, which would have proved any one of the permanent structures to be more economical. In 1917 these annual charges for a renewal in kind would amount to about $1600, due to the increased cost of timber and capital. Even this, however, would be more economical than any of the permanent schemes outlined. The chances are that when this wooden structure would again need renewal, capital would be cheaper and war prices on material would not be in force.

There is also a chance that even where the annual charges on a wood structure would now be higher than those for a permanent structure, the sum of the annual charges to carry a wood structure 12 years and thereafter a permanent structure would amount to less in 50 years than to construct the permanent structure at present.

As stated in the wood-trestle illustration, the price of capital will sometimes change the type of structure entirely. One of the important elements of annual charges is the interest required to finance the construction. In the case of a permanent structure with low maintenance charges and long life but high original cost, the interest on the money invested is the main factor in the annual charges. Consequently when the price of capital is high, it pays to install structures with low original cost and await a more favorable period to construct a better structure.

The labor market is very peculiar in that, although the price of labor has not made such a large proportional advance as some of the other items, still the supply seems to be limited. If a structure required speedy construction, the labor item might be the main reason for choosing a type of structure on which the per cent of labor cost was low. In 1914, when labor was plentiful and cheap, it might have been economical to choose the type of structure with a high per cent of labor cost.

The foregoing statements indicate a few of the many things affecting the design of a structure which can be changed by fluctuations in the price of materials. It can readily be seen that standard practice of the past is not always the most economical at the present, and the engineer who is not up to date on prices of materials is not competent to judge the design of a structure.



PIPE LAID BEFORE PLACING CONCRETE CRADLE

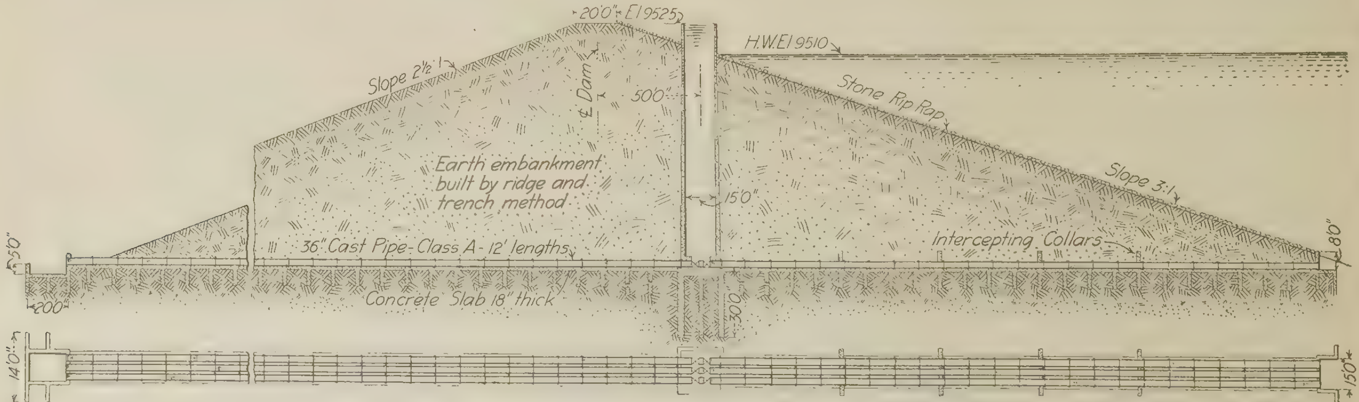
Build High Earth Dam by Alternate Ridge-and-Wet-Trench Method

Outlet Pipes, Laid on Concrete Slab, Pass River Discharge During Construction of Dam for Colorado Irrigation Reservoir

EMPLOYING the ridge-and-wet-trench method, an earth dam 120 ft. in height is being built on Costilla Creek, in northern New Mexico, near the Colorado line, about 60 miles southeast of Alamosa, Col. During the construction the creek will be diverted through the permanent outlet pipes, laid in advance during the past season. The dam, designed to create a reservoir for irrigation purposes, will impound about 15,000 acre-feet of water. It is being constructed for the Costilla Estates Development Company, to supplement the supply now furnished by the Sanchez reservoir, described in the Engineering Record of Feb. 4, 1911, page 130. The water will be diverted at an existing dam 20 miles downstream.

CONCRETE CORE WALL EXTENDS INTO UNDERLYING CLAY

The dam will have a slope of 2½ to 1 on the downstream side and of 3 to 1 on the upstream side, which will be paved with 18-in. riprap. Its top, 20 ft. wide, will extend 600 ft. across the cañon. There is no solid rock at the site of the dam within reasonable limits of



VALVE GATES OF CAST-IRON OUTLET PIPES CONTROLLED FROM TOWER SET UPSTREAM FROM CREST depth. As a precaution against percolation through the foundation material, which consists of a firm clay intermixed with gravel, a thin wall of concrete has been placed entirely across the site and up the sides of the valley to a level about 50 ft. above the natural surface at the bottom of the depression. This wall is carried to a depth of 30 ft. into the foundation material across the bottom of the site and to a distance of not less than 10 ft., normal to the slope, into the sides of the cañon. It extends at all points 5 ft. above the natural surface. The wall, 2 ft. thick, is reinforced throughout with ¾-in. twisted steel rods, spaced 3 in. in from each face. Both horizontal and vertical reinforcing are used, the rods being spaced 2 ft. apart each way.

DAM TO HAVE PIPE SPILLWAY

A spillway is provided through the ridge of the basin at one end of the dam. It consists of an open cut and a concrete structure leading to a riveted steel pipe, which will discharge the water back into the stream below the dam. The pipe, which is of ¼-in. steel plate, will be supported by concrete piers 25 ft. apart. It will be anchored to these piers by steel rods set in the concrete and bent around the pipe in the form of hoops.

The outlet pipes by means of which water will be drawn from the reservoir as desired extend entirely through the base of the embankment. Cast-iron pipe was adopted in preference to concrete, according to the engineers, because of the greater certainty that it could be made watertight under pressure. Above the gate tower the pipe will be subjected to a head corresponding to the height of water in the reservoir. These outlets consist of three lines of 36-in. cast-iron pipe placed in a heavy slab of reinforced concrete carried on supporting walls 12 ft. apart. The walls extend into the original ground 10 to 25 ft., depending on the class of material and the distance from the gate tower, the greater depths being near the gate tower. The piers were built first and the pipe laid on them, being supported just back of the bells. The joints were calked and the lines tested to a pressure of 100 lb. per square inch. The reinforced-concrete slab in which the lower half of the pipes is incased was poured around them after they were tested.

GATE TOWER PLACED UPSTREAM FROM CREST

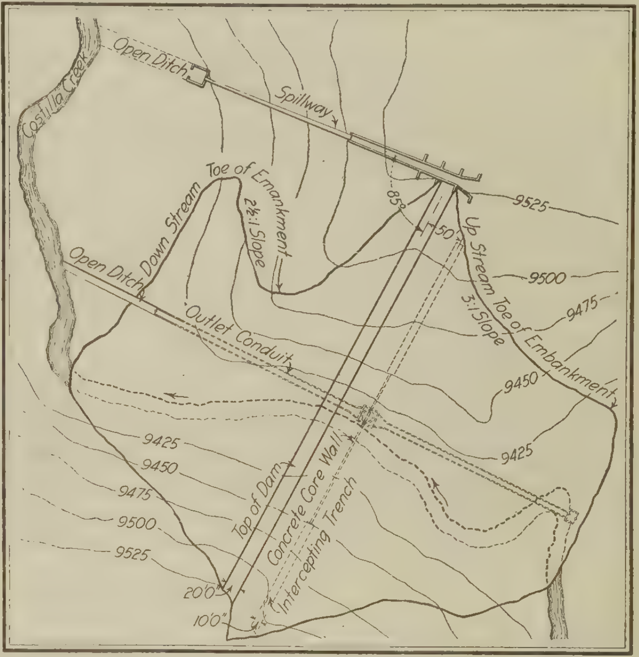
The circular tower for operating the gates is located 50 ft. upstream from the center line of the embankment. The regulating gates in the base of this tower consist of two sets of three heavy 36-in. Rensselaer valves each. The upstream sets are for emergency use only and will be open except when the other set is under repair. The other set will be used as the regular service gates to draw off water from the reservoir. The valves are flanged, and the connection between the corresponding valves of each set consists of a flanged special of the same diameter as the outlet pipe. The gates are to be controlled by 3-in. steel stems extending to the top of the tower. They will be actuated by hand wheels, so geared that they can be operated by one man. The tower itself has an inside diameter of 15 ft., with walls 24 in. thick at the base, diminishing to 15 in. at the top. Its foundation extends to a depth of 33 ft. into the material underlying the site.

The intake end of the conduit is protected from débris and driftwood by a steel cage of angles and channels. The total openings through this grating approximate two and one-half times the area of the outlet pipes. This cage is set in the top and front of the inlet structure.

OUTLET HAS WATER CUSHION

The outlet end of the conduit is a heavy concrete structure that effects at the same time a drop and a water cushion, or pool, for breaking the force of the issuing water.

If the reservoir were full and all gates open, the velocity of discharge through the outlet pipes would be about 40 ft. per second. This condition, however, is practically impossible, as the surplus run-off from flood discharges will be cared for by the spillway. In ordinary service the outlet tubes will never be required to pass more than 300 ft. per second, involving a velocity of about 10 ft. per second.



CORE WALL OF COSTILLA CREEK DAM IS UPSTREAM FROM CENTER LINE

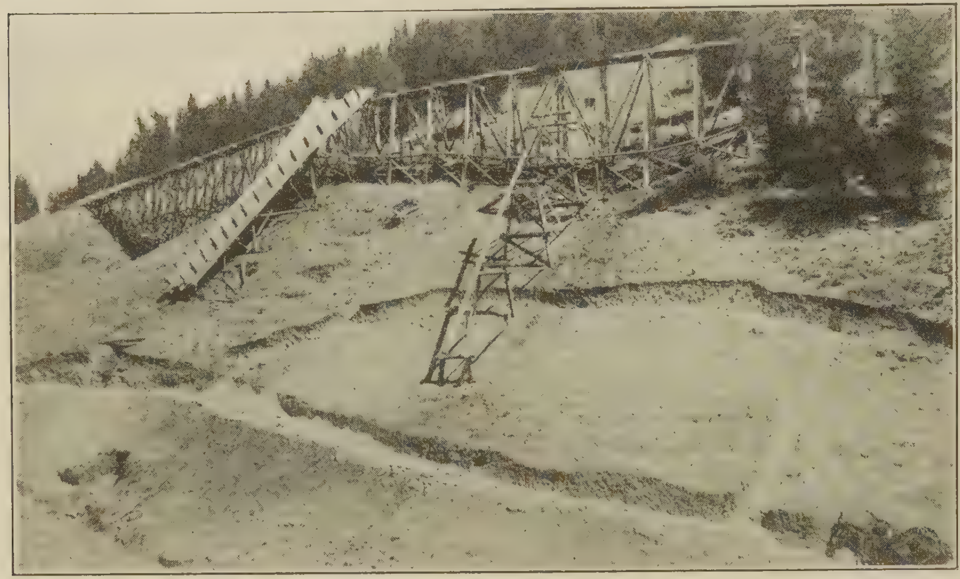
FILL DEPOSITED IN ALTERNATE DRY RIDGES AND WET TRENCHES

The material used for the construction of the earth embankment is to be transported from borrow pits located about 4000 ft. from the site of the dam. It consists of a firm clay mixed with gravel. The material will be loaded by a steam shovel into 3-yd. cars, hauled to the dam site over a railroad constructed for the purpose and dumped into loading chutes, from which wagons will distribute it upon the embankment. The equipment used is the same that was employed in building the Sanchez dam, and the work is in the hands of the same contractor, M. A. Wogam, of Denver.

The material will be deposited in low ridges about 5 ft. in height separated by trenches. The trenches will be partly filled with water and then filled to the level of the adjoining ridges by earth dumped from the ridges. New ridges will then be constructed vertically over the position of the trenches, with trenches between them vertically over the preceding ridges. The embankment will be completed with a succession of these operations, the top of each preceding ridge becoming the bottom of the succeeding wet trench, and conversely, throughout the entire process of depositing fill.

MATERIAL HAULED LONG DISTANCE TO SITE

All the material, including the 164 pieces of 36-in. cast-iron pipe, had to be hauled by team over a mountain road from Jaroso, the terminus of the 32-mile line of the San Luis Valley Southern Railroad Company, which connects with the Denver & Rio Grande Railroad at Blanca, Col. The branch road is the property of the Costilla Estates Development Company.



MATERIAL FOR FILL DELIVERED ON TRESTLE AND DUMPED DOWN CHUTES TO WAGONS FOR DISTRIBUTION ON DAM

The designs for the dam were prepared by J. C. Ulrich, of Denver, under whose supervision the construction is being carried out. The assistant, or resident engineer, in direct charge of the construction, is Neil C. Vandemoer, of Denver. The cost of the dam will be about $350,000, and it is planned to complete the structure during the fall of 1917.

A Unique Road Model

The Pennsylvania Highway Department has had an unusual model made to show just how the relocation of old roads betters traveling conditions. This model measures 6 x 5 ft. and was made by a specialist in such work at Washington. It is in relief, with roads, fields, houses, trees and other features of the landscape reproduced to a correct scale. On it are shown three types of poorly located roads frequently found and the proper methods of relocating each so as to provide satisfactory grades and connect the terminal points in the most direct manner. The model also shows three types of road construction—waterbound macadam, bituminous concrete and cement concrete—with bridges and culverts of standard types. The model is being shown at county fairs and has attracted unusual attention, so it may be considered a decidedly successful educational exhibit which other state highway departments may find it desirable to duplicate.

Intake Gate Designed to "Skim" Colorado River Water

Imperial Irrigation District Announces Plans for Headworks of New Type to Collect Water Without Silt

A REINFORCED-CONCRETE headgate intended to skim off only the upper strata of water where the least sediment is carried has been designed for the Imperial Valley irrigation system. The improvement will be known as the Rockwood intake gate and is an item on the construction program recently recommended by C. E. Grunsky and George B. Anderson, consulting engineers for the Imperial Irrigation District, for immediate attention. The new intake, about 6000 ft. upstream from Hanlon Heading, will be supported on river silt of unknown depth; accordingly, it was designed broad enough to distribute weight over a large area. It was desirable to reduce the velocity of the inflowing water and to draw from a minimum depth. Taking these two points into consideration, the structure was made 60 ft. wide and 645 ft. long.

The superstructure will be founded on a concrete floor with Wakefield sheet piling cutoff walls driven 30 ft. below the sill, level along both up and down stream edges of the floor. A series of piers 8 ft. apart, parallel to the direction of flow, will be supported on the floor and will carry three pairs of vertical grooves for three separate tiers of stoplogs, by means of which the flow into the canal will be controlled. The piers also carry a reinforced-concrete trough running the entire length of the structure, which is to be filled with earth and rock to give additional stability. A railroad track will be laid on top of the fill in the trough.

The opening between piers will be 6½ ft. in the clear. Twenty-seven of them will have gate sills at an elevation of 96 ft.; the sills in the remaining 48 openings will be placed at elevation of 104 ft., this arrangement being planned to provide sufficient capacity at extreme low-water flow without the expense of building a structure which could draw from these low levels along its entire length. At the point where the transition is made from one sill level to the other there will be a concrete box 25 x 60 ft. in plan, extending the full height of the piers, which is to be filled with earth and rock to increase the weight of the structure at this point.

TO PROTECT BANK WITH REVETMENT

It is planned to protect the bank adjacent to the structure above and below the concrete work with rock revetment. As the shore line is to be moved back a considerable distance it will be possible to place this revetment in the dry by excavating a trench along the desired location, filling in the rock and afterward dredging the foreshore remaining between the rockfill and the edge of the stream. The revetment work will extend 200 ft. from the structure each way, and is to be placed in trenches 10 ft. below sill level and 6 ft. wide on the bottom. Immediately in front and along the entire length of the intake proper a rockfill 25 ft. wide and 6 ft. deep is to be placed in the channel, with its top below sill level.

The work is expected to cost about $200,000. Specifications require its completion by May 1, 1917. The contract was to have been awarded on Jan. 12.

Auxiliary Pipe Lines Necessitated by Failure of Dam

Second-Hand Woodstave Pipe Found Economical in Solving San Diego's Problem—A Diverting Dam Also Built

By A. C. FRANCIS

Operating Department, San Diego, Cal.

SAN DIEGO, CAL., has just completed the construction of pipe-line connecting links in the water-impounding system of that city made necessary by the failure of the Lower Otay dam, reported in the Engineering Record of Feb. 12, 1916, page 225. The first step taken toward rehabilitating the water system was to connect an auxiliary basin of 1,090,000,000 gal. capacity with the Otay-San Diego pipe line leading to the city by means of a 36 and 24-in. woodstave pipe line, 15,000 ft. long. About 1500 ft. of the 24-in. continuous wood stave was second-hand pipe which had been replaced by cast iron in a city street, and it is worthy of note that a saving of $1,500 was made by using this old material. The total cost of the connecting line was $41,369.

BUTTRESSES PROTECT DOWNSTREAM FACE OF DIVERTING DAM

In order to divert the water carried from the Morena reservoir higher up on the system through the Dulzura conduit, and the Dulzura Creek from its old course over the Lower Otay to the Upper Otay and the mains leading to the city, a 36-in. woodstave line designed to carry 20,000,000 gal. daily was built from the Upper Otay reservoir to a diversion point on the Dulzura Creek, a distance of 23,700 ft. At Harvey, a diverting dam 400 ft. long, built of reinforced concrete, takes the flow from the creek and turns it into this line.

The woodstave pipe lines were laid by the Pacific Pipe & Tank Company, the city of San Diego doing all excavating and trestle construction.

Few New Buildings in Porto Rico Because of High Cost

Repair Work Is Biggest Item—New Construction Held Down by Increase in Price of Building Materials

ALTHOUGH building activities in Porto Rico for the year ended June 30, 1916, increased over the preceding year, the work is found to have consisted almost entirely of repairs and additions rather than of construction of new buildings. This was caused by the advances in the cost of building materials, especially in the price of lumber. An increasingly large proportion of the new buildings are constructed of concrete, according to the report of the director of sanitation of Porto Rico, from which these notes are taken. In Spanish times the better class of buildings were made of what is known as *mamposteria*, which consists of broken bricks and stones laid in a weak lime mortar. In some cases the mortar was made of clay and very little lime. This was generally faced with soft burned bricks, to protect which the outside was plastered. In many instances the walls were so poorly constructed that rats readily made holes through them, and there were frequently large hollow places in the walls which afforded excellent harboring places for these rodents. Cases are known where rats have gnawed holes through the soft bricks.

CONCRETE BUILDINGS USED MORE

Such construction is no longer permitted. It is not economical, because the old walls had to be made very thick. The much thinner and more solid concrete walls are now less costly. A number of years ago many buildings were constructed of concrete blocks, but they were found to be less satisfactory and more expensive than solid concrete walls reinforced with steel rods. A great many of the Porto Rico workmen have become expert in the decoration of concrete work, and unfortunately some of the newer buildings exhibit a regular riot of architectural adornment, continues the report. This phase of building must necessarily be only a passing fancy, for it is believed that the many examples of old Spanish buildings of dignified and solid construction will surely exert a restraining influence.

SUMMARY OF PORTO RICO BUILDING ACTIVITIES

Year ended June 30	New buildings	Repairs and alterations	Total
1913	1470	333	1803
1914	837	531	1368
1915	722	443	1165
1916	723	479	1202

The many and disastrous fires on the island during recent years have also discouraged the construction of wooden buildings. The sanitary regulations require the use of concrete in many cases for the purpose of rat-proofing and cleanliness. These changes in construction have materially improved the sanitary condition of buildings throughout the island.

What Does "Permanent" Really Mean?

The Illinois State Aid Law has been so amended that it recognizes the existence of "permanent earth roads."

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

A New Era in Teaching English to Engineers

SIR: I have carefully read the article on page 291 of the issue of Feb. 24 of the Engineering Record and wish to state that the University of Cincinnati and the Massachusetts Institute of Technology are not the only schools where engineering students are taught engineering English.

First of all, the English courses at New York University are given with a big distinction in instruction between the arts students and the engineering students.

Then, again, the instructors in charge of the engineering students have been teaching this course at this university for the last five years and have been using no textbooks but periodicals, including the Engineering Record, for the last four and one-half years.

Does not this show that M. I. T. and the University of Cincinnati are not the only schools where engineering students are taught engineering English?

Brooklyn. DICK A. DUPLER.

SIR: In reading the Engineering Record of Feb. 24 it seemed to me that your editorial dealing with "A New Era in Teaching English to Engineers" was not absolutely correct, since it left out New York University, which has been teaching English to its engineering students in a similar or better way for the last eight years.

Not only is technical writing taught, but the Engineering Record has been used in the course for more than four years, in lieu of a better textbook. You can see from the 1917 bulletin of the School of Applied Science that the course in English, as given to the undergraduate engineer, is along the lines of writing for which he will have the most need after graduation.

HENRY W. PARKHURST,
New York City. Class 1919, N. Y. U.

[Mr. Parkhurst and Mr. Dupler have apparently read into our editorial a meaning which is not there. It must not be assumed that commendation of the work done at the Massachusetts Institute of Technology and the University of Cincinnati implies that English is taught well only at these two institutions.—EDITOR.]

Use of Contractor's Plant by Engineer Troops in the Field

SIR: I have noted with interest the articles by Lieut. C. E. Bregenzer, 22d New York Engineers, published in the Engineering Record of Jan. 13, page 46, and Jan. 20, page 101. The articles in general give an excellent idea of the work of engineer troops, and seem to call for remark as to but one particular. This is found in the issue of Jan. 20, page 104. Here the suggestion is made that engineer equipment of troops should include general contractor's plant, such as caterpillar tractors, pumps, air compressors, drills, road machinery, trench excavators, etc.

Lieutenant Bregenzer is correct in thinking that such equipment should be available when required, and the Engineer Department provides accordingly. Its proper place, however, is not in the combat equipment of troops but in the engineer columns behind the army, and in the engineer depots from which it can be sent forward as required and as conditions permit.

To make clear why such equipment has not been included in the field or combat equipment of engineer troops, it is necessary to consider the conditions under which engineer troops have to act on the work for which their normal equipment must be designed.

Engineer troops must be able to maintain their position in a marching column, composed of all arms of the service; they must not take up too much road space or interfere with the marching efficiency of the column. If they violate these conditions they will promptly be relegated to the rear, and instead of performing their proper functions will find that they might just as well have stayed at home. Pioneer troops, with a mobile force in the field, do not ordinarily have time to carry out such extensive work as to call for elaborate contractor's plant. They must be primarily equipped to do rough and ready bridge work, field fortifications, demolition work, etc., but must also be able, if operations slow up enough to permit it, to do more elaborate work with the heavy plant of the engineer columns and depots.

Until a few years ago the combat equipment of engineer troops contained a much larger amount of engineer tools and equipment than it does now. The amount of this equipment was so great as to interfere seriously with mobility, and after very thorough consideration a greatly reduced equipment was adopted, which meets the consensus of the best opinion in our service, and is closely similar to what is in use in the engineer services of the principal foreign armies. W. M. BLACK,
Brigadier-General, Chief of Engineers, U. S. Army.
Washington, D. C.

Test of Low-Lift Drainage Plant

SIR: In the Oct. 7, 1916, issue of the Engineering Record, page 437, there was published a description of a low-lift drainage plant consisting of centrifugal pumps direct-connected to distillate engines. Since this article was written the final economy test has been run, and the results of this test show very clearly the small cost of fuel for draining lowlands in this territory when economical pumping machinery is installed. The head during the test ranged from 4.44 to 5.91 ft., the mean head being practically 5 ft., at which head most of the pumping will be done in actual service.

The fuel was a low-grade distillate costing about 5½ cents per gallon. During the test the fuel pipes were disconnected from the oil-supply tanks, and weighed oil poured into a bucket, from which it was drawn by the fuel pump.

The quantity of water pumped was determined by Pitot tubes in both suction pipes, with a tube in the discharge as a check. Simultaneous readings were taken at the three points. The head, or rather lift (as guarantees are based on difference in levels of suction and discharge canals), was obtained by simultaneous readings of gages in the suction basin and outfall canal.

The guarantee was exceeded by 15 per cent on an average of the eight sets of observations. The test was conducted by A. M. Shaw, engineer representing the purchaser, and by the writer, who was engineer for the contractor, A. M. Lockett & Company, Ltd.

The average runoff handled by a drainage plant in Louisiana is 24 in. per year, or 2 acre-feet per acre. The results show that 28,775 cu. ft. of water was removed per gallon of fuel, so that 2 acre-feet, or 87,120 cu. ft., would require practically 3 gal. of fuel, which at 5½ cents gives the fuel cost per acre per year at 16.5 cents.

This means that the fuel is the smallest item of maintaining and operating such an installation; interest on the investment in plant, canals, and levees (or in the care of a drainage district interest on the bonds) being the largest. On another similar small drainage district that has been under cultivation for several years the cost to the farmer for drainage, including interest, fuel and operation, has been about 75 cents per acre per year.

This indicates that it is a better proposition for the farmer to use drained rather than irrigated land, as the water tax on irrigated lands in the Rio Grande River Valley, for instance, is about $10 per acre, and in the rice district of Louisiana and Texas about $5.

New Orleans. B. S. NELSON.

Compensation of Engineers

SIR: We have read a great deal recently of the decreased enrollment of engineering students, as well as the compensation of engineers, which in general have been theories and not facts. Let us examine an existing organization and see what we find.

Our example will be one of the largest employers of engineering talent in this country, whose maintenance of an engineering organization of several hundred members for special improvements and developments should be a criterion of the general conditions in this particular field. In passing, this corporation prides itself on its merit system, and distributes considerable literature to its employees and the public boasting of its organization, its taking care of its employees and its general esprit de corps, as well as having the reputation of maintaining a very efficient engineering force.

The following figures of the compensation of this engineering organization are approximately correct: Six per cent of the employees of this organization receive in excess of $3,400 per year, 6 per cent between $3,400 and $3,000, 3 per cent between $3,000 and $1,800, 15 per cent between $1,800 and $1,400, and 70 per cent between $1,400 and $600, or an average yearly compensation of about $1,600.

On account of lack of space we will not be able to analyze the workings of this entire organization, so will take the field force, which is typical. This force has direct charge of the planning and execution of the work in the field. We will, for comparison, divide this force into three classes—A, B and C.

Class A—Here we find those unfortunate men, the real unsuccessful type, on whom someone earlier in life would have conferred a great favor by discharging and having explained to them their utter unfitness for the work. They are the minority.

Class B—In this class are the easy-going men who just happen to be engineers of a kind, some with a little knowledge, but most of them through years of service have naturally absorbed enough to run an instrument, make a tracing, solve a plain triangulation, are good inspectors—in fact, are very essential in the makeup of a field force, as they are the majority and do just what they are told.

Class C—This is the valuable class, the members of which do things, have their employer at heart, and by work and observation are striving to better themselves in this their chosen field.

A salary adjustment in this organization within the past year is typical of the system which seems to place a premium on incompetence. To illustrate: Mr. B. of the indifferent class, who is entirely dependent on Mr. C. for instruction as to just what to do, having no initiative, received $100 per month and by the adjustment received $120 per month. Mr. C. received $150 per month, but received no increase by this adjustment, as it set a salary limit of $1,800 per year—that is, $1,800 is the maximum salary limit for anyone receiving $1,800 or less, according to this new ruling. By implication the capable men are asked to resign. It is implied that they are not needed, for surely a young man would be foolish to continue in this organization in view of this munificent zenith of $1,800 per year.

The unfortunates are those of capacity who have given ten or fifteen years of the best part of their lives to a corporation which, when their experience, initiative and executive ability make them most valuable, says, "We will pay you no more, but we will increase the salaries of the less deserving."

What are the defects of this system? Indifference or ignorance of the duties and responsibilities of the lower salaried units of the organization by the authorities that set salary limits seems to be the chief defect. Why this indifference or ignorance? This condition is not the fault of the immediate department heads, among whom are some of the best executives and engineers to be found in the country. The salary limits are set by the powers higher up, who seem to think the remuneration of an engineer and a chauffeur should be the same.

The economics of this sort of salary adjustment seems to be personified in a hearsay quotation of a directing official when presented with a list of salary increases recommended by a department head: "What is the use of raising their salaries, they won't quit." Yet we are told one of the first rules of success is to show your ability to your superiors who can help you.

In this force your direct superiors are helpless, and the average man on an engineer corps has not as much chance to become acquainted with the general office staff as the general office elevator man, who at least sees them more frequently.

Of course, the outcome of such a system is ultimate failure, but this does not help those who by circumstances cannot start at the beginning again to build up prestige with some other concern. Yet, in view of this condition, you will find captains of industry, bankers and prominent business men anxious to place their sons in this organization. There is something wrong with the publicity department, but—"What are you going to do about it?" A SUBSCRIBER.

SIR: On reading the article on salaries of engineers in your issue of Jan. 13, the first thing which strikes me is the height of the average salary as shown.

I judge that these figures tell the truth as to the large proportion of the A. S. C. E. membership which has reported, and I judge from my eighteen years' experience that these figures do not fairly represent the many thousands of civil engineers, not members, from recent graduates to old men.

We all know that A. S. C. E. members are but a fraction, though truly the leading fraction, of all civil engineers. I consider that the figures given are cruelly misleading to the several thousands of young men who yearly enter and graduate from our engineering schools. I would like to see reliable figures on nonmembers of the A. S. C. E. from top to bottom.

In the U. S. Interstate Commerce Commission, in the particular division with which I am connected, a quick count shows that 820 men of all grades of civil engineers, of long and short experience, receive an average of $1,201 per year plus an average of $333.50 expense allowance per year—decidedly below the figures shown for even an experience of from one to five years.

My experience with railroad engineer departments would lead me to believe that the figures I cite would also apply approximately to the railroad civil engineers of the land.

Albuquerque, N. M. W. H. BARNES.

Water the Chief Factor in Making Concrete

SIR: The writer has been very much interested in the discussion which has taken place in your columns since Nathan C. Johnson's article, entitled "Water the Chief Factor in Making Concrete," appeared in your Dec. 30 issue.

After all that has gone before in this important discussion I desire to call attention to the use of a small percentage of hydrated lime for the purpose of eliminating segregation, either wholly or in a great degree, from a practical viewpoint.

The desire for using excessive quantities of water in placing concrete is brought about more particularly by the desire on the part of the construction superintendent to "get the concrete into the forms." In order to maintain speed it is necessary that a concrete have two qualifications; that is, it must be sufficiently mobile to permit free movement through the chutes without segregation and it must be sufficiently plastic to be easily worked in the forms. If a mixture upon being placed would possess these two important qualifications, the desire for increasing the quantity of water would not arise. Therefore it seems that the question to be solved is one of finding a material that will introduce into the mixture these two qualities.

The following from a letter recently received from R. C. Hackley, engineer for R. C. Storrie & Company, the contractors who are erecting the Twin Peaks tunnel in San Francisco, indicates just how effectively hydrated lime performs in placing concrete without segregation:

"The city engineer, M. M. O'Shaughnessy, wishing to have the tunnel as dry as possible, specified the use of hydrated lime in the concrete in the proportion of 8 lb. of lime to 100 lb. of cement. The concrete is mixed in the proportion of 1 part cement and 8 lb. hydrated lime, 2¼ parts well-graded sand and 5 parts crushed gravel graded from ¼ to 1¼ in. The mix gives a perfectly watertight concrete, although the ground passed through by the bore contains a large quantity of water.

"From the contractor's point of view the lime in the mix is a great advantage, as it holds the water in the mix, preventing separation and allowing a wet mix, which is necessary when placing through a long line of pipe, as is done on this work.

"On this work the pneumatic concrete placing system is used, and we have shot the concrete 2600 ft. through 8-in. pipe and expect to extend this line to 4000 ft. or more, the lime being a great help as a lubricant. Where chutes are used they can be much flatter and will carry the concrete much farther with lime in the mix; in fact, we have used lime for this purpose and for easier placing in narrow walls and around reinforcement, even when not specified, on account of the labor saved.

"When concrete is transported in cars, or carts, the lime in the mix is a great aid, as there is not the separation of the aggregate from jarring, as is the case when no lime is used.

"The contract will require more than 100,000 cu. yd. of concrete, practically all of which will contain hydrated lime. Up to the present time over 1200 tons of lime has been used in the work, and about 400 tons more will be required.

"The uniformity of concrete on this piece of work and the absence of honeycomb patches can be greatly attributed to the use of hydrated lime. From the contractor's standpoint the additional cost of the lime is greatly compensated for by the saving in labor in placing the concrete and absence of rocky places to be cut out or plastered up when forms are stripped."

The question may arise as to what effect hydrated lime has on the strength of concrete, and to this there can be but one answer. The Bureau of Standards, in Technologic Paper 58, states:

"The compressive strength of concrete may be reduced by the use of an excess of water in mixing to a fractional part of that which it should attain with the same materials."

It will therefore be seen that by preventing segregation hydrated lime must be regarded as being a material that will have no other effect than to increase the strength of the concrete.

Particular attention is called to Mr. Hackley's statement that hydrated lime has been used in portions of the work, even where not specified, on account of the labor which is saved.

Mr. Johnson, in his article, makes certain recommendations for overcoming the poor practice by running the excess water, together with the fine cement, off through holes in the form boards, etc. Would it not be considered far better and more effective to eliminate the root of the evil—that is, the desire on the part of the concreting foreman to use more water—and especially so since it can be done effectively and with very little, if any, increase in the cost per cubic yard of concrete?

HYDRATED LIME BUREAU,
Pittsburgh. Norman G. Hough, Manager.

SIR: I have read with a great deal of interest the letter to you from Edward Godfrey relative to Nathan C. Johnson's article on "Water the Chief Factor in Making Good Concrete," and Mr. Johnson's reply to the same, both of which were published in your issue of Feb. 24. It appears to me that both parties agree that excessive water in mixing concrete is detrimental to the material and that only enough water should be used to give a dense, homogeneous mass which will flow freely around the reinforcement and completely fill the forms at all points. I gathered the same impression from Mr. Johnson's original article in your issue of Dec. 30, 1916, and my own experience in concrete work bears this out.

The point that interested me most, however, was Mr. Johnson's statement relative to the 1½-minute mixing period, as recommended by the Joint Committee, and as to how many members of that committee are requiring this in their specifications. During the last year and a half I have written the one-and-a-half period of mixing into all my specifications and have personally seen to it that this provision has been lived up to by the contractors doing the work. For five years before that I followed the same practice on force-account work with very good results—insisting, of course, upon the proper consistency of each batch of concrete that was turned out.

It would be very interesting to know just how many engineers follow this practice and how many do not. I sincerely hope that all members of the Joint Committee will answer Mr. Johnson and let us all know what they are doing.

W. N. JONES,
St. Paul. Designing and Constructing Engineer.

Are Engineers Professional Men?

SIR: I have read the extracts from Professor Newell's address in the Engineering Record of Jan. 27, page 146, and your editorial comments thereon. That Professor Newell should propose a preposterous definition of the term professional engineer to fit his assumptions and arguments is sufficiently surprising; that the Engineering Record should editorially sanction and approve such a definition is little less than astonishing.

Professor Newell lays down two criteria for distinguishing the professional engineer from the non-professional engineer—the relation to the client and the manner of compensation. If the engineer is "his own boss" and calls his compensation a fee or an honorarium he is entitled to be regarded as belonging to the profession; if he works under the instruction of a client and accepts a stipulated rate of "wages" he is not a professional engineer. He is merely a skilled mechanic.

According to this definition there are very few professional engineers. General Goethals was appointed by, and built the Panama Canal under the control and direction of, the U. S. Government, and he received a stipulated salary. The distinguished and veteran engineer who designed and built the Hell Gate Bridge did the work in the employ of a railroad company and under its general direction, and received, no doubt, a liberal "honorarium" at stated periodic times. According to Professor Newell's proposed dicta they are both outside the pale of the profession.

In fact, the number of engineers who dictate to and control clients in the autocratic manner the professor speaks of, and are actuated mainly by altruistic motives, is so small as to be negligible. This is practically as true of the doctors and the lawyers as of the engineers. While actuated by high motives and conforming to high standards of honorable conduct, the simple fact is that they are, like other people, working for a living—and it is no discredit to them. Nor does the fact prevent them from being honorable members of their profession.

Considering the facts as they actually exist in engineering practice one wonders just where Professor Newell would draw the line between a fee or honorarium and a salary; or to what extent the engineer must be under the control of the client to shut him out of the profession.

The proposal of Professor Newell to read out of the profession the great majority of the able and honorable engineers of the country in order to justify his views on publicity and on making the professional societies employment agencies for their members will certainly be resented by the vast majority of those he proposes thus to serve. Most of these societies were organized and so far have been conducted with a higher motive than the promotion of business engagements. The constitution of the American Society of Civil Engineers states its objects to be "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members." Shall we amend it by adding *and the laudatory advertisement of its members and procuring for them of profitable engagements?*

To a certain extent and in a proper manner an engineering society may advance the business of its members by promulgating correct ideas of the high character, ability, honor and fitness to be trusted in public or private enterprises of the members of the profession generally. But it will be a sad day for these societies when they give the public reason to infer that one of their prime purposes is to promote the business interests of their members.

Professor Newell refers to the professions of medicine and law. What would he think of their national organizations if they made it one of their avowed purposes to procure patients and clients for their members?

If engineering is ever to merit recognition as a real profession the line between legitimate professional activities and the promotion of personal business interest thereby must be even more closely drawn than it is now. There must come to be either a true profession of engineering or an organization something like a guild of scientific, skilled mechanics and specially trained business men.

Engineers themselves must decide the question which of the two it shall be.

S. WHINERY,
New York City. Consulting Engineer.

SIR: To the vast majority of men that make up the rank and file of the engineers of this country the article in the Engineering Record of Jan. 27, abstracted from an address by Prof. F. H. Newell, giving a definition of a professional engineer, coming as it did on the heels of the report of the American Society's Committee on Compensation, cannot but be discouraging. It was bad enough for a technically trained man to be told that the average compensation for engineers was close to $4,000 a year, and that if your compensation was not included in that average you could not be considered a regular engineer; but to have the next issue come out with the statement that as long as you worked for wages or a salary, as the case might be, you could not be considered a professional man is to make us wonder whether, after all our years of preparation, we are to be relegated to the mechanic's class simply because we are forced by necessity to work for wages rather than open an office and starve.

The majority of engineers, the men who do the field work, drafting, designing and preparing of reports and budgets, seldom get a chance to see a $4,000 engineer except at lectures and other side shows, and to tell them that they really are not fitted for their jobs, when they are able to direct a field party or design every detail of a construction job, is a trifle too bizarre to be taken seriously. To be told that a county surveyor or engineer who happens to be on the winning side long enough to hold his job five or six years, or a man whose sole stock in trade is a Jacobs staff, mountain transit, office desk and limited knowledge of land surveying, is entitled to be called a professional man, while the technically trained, experienced governmental or railroad employee is still in the mechanic's class, is, to put it mildly, a bitter dose to swallow.

Professor Newell's definition of a professional man—that none are eligible who receive orders or a salary—would exclude from membership all railroad engineers from chainman to chief engineer of the system, all city and state, all governmental and Army engineers and, indeed, all who are not in the one class of consulting engineers. Even among the lawyers the brightest stars of the guild would be excluded under a strict interpretation of the definition, since they certainly receive regular retainers at stated intervals.

As for the technical difference between dictating and being dictated to, is a man less dictated to when his orders are to secure a piece of property in a legal way than when his orders, originating from the same source, are to build a railroad or erect a building on this same land? It would seem to be a distinction without a difference. But even so, the fundamental difference between law and engineering would seem to necessitate a broader application when applied to engineers, since the doctor and the lawyer may look upon every human being as a possible client, while the engineer must deal only with those who possess property or money, since he cannot work without something tangible to work on. The dictionary defines profession as "a vocation," and since it is impossible to conduct an efficient engineering practice without the aid of salaried men who are technically trained in this particular vocation, let us keep our dignity, at least enough to take pride in our "professional" accomplishments.

If the member of the profession who possesses sufficient executive ability and salesmanship to provide himself with an office desk and a stenographer really wants to be differentiated from the salaried man, let him choose a different title. The lawyer calls himself counsel or the doctor a specialist after he has elevated himself to the high-retainer class, but let the rest of us dub ourselves professional engineers when our life vocation is professional engineering, even though our emoluments may be derived from the lowly pay envelope.

HAROLD A. THACKRAY,
Engineering Department, Chicago & Western Indiana Railroad.
Chicago.

SIR: I have read the article by Prof. F. H. Newell in your issue of Jan. 27, together with your editorial comment thereon.

I cannot agree with you in your definition of what constitutes a "professional man." Why should a man cease to be a professional man because he receives a certain fixed sum per month or per year for his services instead of such fees as he sees fit to accept for those services from time to time?

I presume that Professor Newell receives a yearly salary as professor of civil engineering at the University of Illinois. According to his own definition he is not a professional man, and yet I cannot conceive any occupation more truly professional than that of teaching the profession of civil engineering.

I have a friend who is chief surgeon for a large industrial corporation. His work takes all his time and that of several assistants. He receives a salary—rather a large one. Is he not as truly a professional man as when he was in general practice, and accepted a fee for each visit, probably making considerably less money?

Would not a better definition of a professional man be something like this: "A man who practises an occupation requiring technical mental training rather than manual dexterity or commercial acumen"?

ARTHUR D. STIVERS,
Pittsburg, Tex. Consulting Engineer.

[Copies of the foregoing letters were referred to Professor Newell, who answers them as follows.]

SIR: The increasing interest which is being taken by engineers in the present status of engineering and of engineering organizations is indicated by the letters above quoted and by others which have been received personally, following the appearance of the article on page 146 of the Engineering Record of Jan. 27.

The main point of the article, and the one which should be emphasized, is that each engineering society, to perform its full functions, must have clearly in view the character and aspirations of the great body of its members and must shape its actions to meet the needs of these members. If the majority of the membership consists of young or middle-aged men who occupy the great intermediate ground of engineering employees, the society is obviously not performing its best functions for this majority if its efforts are concentrated on details which are of value to a relatively few of the older or more influential men. It makes little difference whether we class these few as professional men or whether we designate as professional all engineers who are not engine runners or mechanics.

No two men will readily agree as to where to draw the exact line between the engineer who is a true mechanic and a man who is generally known as a member of the engineering profession. Between these two extremes are thousands, or even tens of thousands, of men faithfully and efficiently occupying subordinate positions, from which they may advance, but never to the broad, independent status. These men are, and should be, the bone and sinew of the engineering organizations. Are they fully recognized as such? On the contrary, are their needs not being generally overlooked in the effort to aid the professional minority?

Some of our larger associations of engineers have been conducted apparently from the viewpoint of the relatively few professional men who have attained conspicuous rank. They consciously or unconsciously impose their standards or ideals upon the mass of the membership. While these in themselves may be excellent, yet there is a large probability that they will not fit the common need nor serve as a stimulus. Such societies are valuable in reaching say 40-per cent efficiency, but after they have attained a certain stage they by their very existence check farther development toward an attainable 100-per cent efficiency. Many, appreciating this fact, are discussing the conditions with a view to bringing about such modifications as will correct the present somewhat anomalous conditions—with the result of either essentially modifying the present organizations or providing others which will more nearly fulfill the needs of the great body of assistant engineers or employees in engineering work.

We as engineers do not gain any particular honor by desiring to call ourselves professional men or to shape our societies in the stereotype form of professional societies, any more than our brothers are dishonored by being called mechanics and forming effective unions. Each and every man has his proper sphere of action and is entitled to all the consideration due to his age and character, whether he falls in the group of mechanics, or of professional men, or of any other classification. Whatever the proper division in which his lifework puts him, he is entitled to unite with his fellows and promote the highest interest of that group. If he is a mechanic he has the right and duty to become a member of a labor union and to advance the highest ideals of that union, since under present conditions that is the way he can register his influence. If he is a professional man he should join a body of professional men. If he belongs to a group which does not fall under either designation, he has the equal right and duty to association with other men similarly situated under a form of organization which will advance the common interest. The principal thing, as above stated, is properly to classify the groups, irrespective of the names given them, and to study the needs and opportunities of each group.

Taking up some of the assertions in the letters, it is not apparent as to why any engineer should be discouraged if, under the general definition of profession, he does not fall within this grade. Nor does it necessarily follow that if a man is not grouped among the professions he must necessarily be a mechanic. Both are honorable occupations, and there are others equally honorable which are neither mechanical nor professional.

Among these groups, for example, are large numbers of engineers engaged in the public service. They can hardly be said to be professional men in the commonly accepted use of the word, nor does it particularly matter. The men in this large group, to be more efficient, should be able to meet together frequently and discuss matters of common interest, increasing their acquaintanceship and strengthening their ability for good.

As regards the criticism of the definition of a professional engineer and suggestions for improving the definition, it may be said that the definitions given on page 146 are not of my devising, and are simply compilations from various sources. Each of us can write his own definition of professional engineer, one which may satisfy him, but this may not be understood nor accepted by the great body of thinking people.

To those men who have ambition to be classed as a member of a profession, there can be only one answer—namely, to wish them success. But, on the other hand, the same good will should be manifested toward the great body of engineers who are not professional men. If they desire to form an organization which, as suggested by Mr. Whinery, may be something "like a guild of scientific, skilled mechanics and specially trained business men," they should be encouraged to do so, as this will include the great body of men engaged in the practice of engineering.

Such men can and should have ideals as high and a code of ethics as far-reaching as that of any professional organization. More than this, they can and should do everything within their power to promote the advancement of engineering knowledge and practice and the maintenance of a high standard among their membership. This is not incompatible with their filling, at the same time, some of the great needs now experienced—namely, studying the methods of employment and devising more scientific and businesslike ways of getting the round pegs into the round holes and the square pegs into the square holes. Such a body can also educate the public in the need of trained men and of better engineering; can emphasize the need and possibility of better roads, better water supply, better sewers and innumerable other items in which engineers are skilled. They can and should, through their organization, take an active part in discharging their duties to society in general, in seeing to it that better laws are enacted, and they can and should adopt or hold before the members the highest code of ethics.

F. H. NEWELL,
Professor of Civil Engineering, University of Illinois.
Urbana.

Natural Cement for Cobble or Brick Gutters

SIR: I should like to know if any of your readers have tried using natural cement in the construction of cobble stone or brick gutters. I have a considerable length of gutters to protect and wish to do it at as little cost as is consistent with good results.

R. T. BROWN,
Board of Road Commissioners, Davidson County, North Carolina.
Lexington.

Kansas University Extension Staff Engineers

University extension staff engineers in Kansas furnished plans, specifications or other information for road, bridge and drainage work of a value exceeding $2,000,000 during the biennial period ended June 30, 1916.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Concrete Blocks Cast with Nail in End Spread Narrow Wall Forms

By J. D. TULLER
Superintendent, Louis J. Sieling, Engineering Contractor, New York City

A NUMBER of 4-in. walls built in connection with a concrete bridge at Holyoke, Mass., constructed during the past season, required forms so close together that the ordinary wooden spreaders were not easily pulled out as the concrete was brought up. To overcome this, the writer made concrete spreaders which could be left embedded in the wall. The forms for these spreaders were easily made by laying a number of 2 x 4s on edge on a platform, 4 in. apart. Between these at intervals of 2 in. short pieces of 2 x 4 4 in. long were placed. This formed a series of pockets 2 x 4 x 4 in. into which mortar was poured. While this was still soft an 8d. nail was placed head down in each section, leaving about ½ in. of the point projecting.

Don't Stop

SENDING IN your "Hints" with the idea that this section will be discontinued after the consolidation of the Engineering Record with the Engineering News on April 5.

NOT MUCH! With your help, the Engineering News-Record will keep right on publishing

HINTS FOR THE CONTRACTOR

In erecting the forms, the back was put up first and then the reinforcing steel was placed. Next these concrete blocks were placed in position by driving them and forcing the spike in the end of each into the back form. This held the blocks in position until the front form was placed. The forms were thoroughly wired and the concrete poured, the spreaders of course forming part of the wall. The ends of the nails were cut off at the time the form wires were cut.

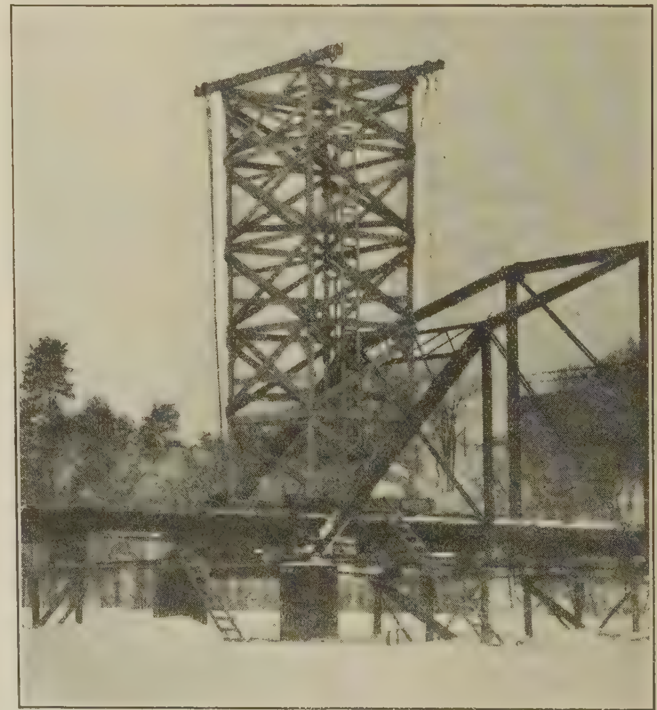
Small blocks of concrete were made in the same way and used as chairs for the reinforcing in floors and stairs. A short piece of small wire was embedded in each block intended to support the stair reinforcing and used to tie the blocks to the rods to keep the blocks from dropping out when the reinforcing was jarred by walking on it or placing concrete.

Light Traveler Wrecks Bridge During Zero Weather in Race Against Rising Lake

By LOUIS G. ARNOLD
Assistant Superintendent, Wissota Dam, Chippewa Falls, Wis.

THE INSIDE traveler shown in the photograph, which moved on four timber dollies, one at each corner, dismantled a 137-ton steel highway bridge in 13 days. The bridge, which crossed the Chippewa River near the mouth of the Yellow River and about 3 miles above the new Wissota dam of the Wisconsin-Minnesota Light & Power Company, had to be removed and replaced at another location because of the completion of the dam and the filling of the storage reservoir. The removal had to be completed in 30 days, as the water rose rapidly. The work was the more remarkable because the steel was dismantled in condition to be reerected and because operations were hampered by extremely cold weather and by the necessity for maintaining traffic during a part of the time.

The bridge, consisting of two 240-ft. spans, 35 ft. deep, carrying a 16-ft. plank roadway at an elevation 33 ft. above the old low-water mark, was supported on 22 three-pile falsework bents with plank and pole sway-bracing. This was placed by framing and stacking the bents for one span on the ice directly under the bridge and raising them into position with tackle, the piles sliding through holes cut in the ice directly under each floorbeam. As the river bottom was coarse gravel, no mud sills were required, the individual length of each pile being determined by actual measurement. The piles were forced to a firm bearing by screw jacks placed under the floorbeams. Filling of the reservoir had been in progress for some time previous to the erection of the falsework, and the ice surface had risen at the rate of about 1 ft. a day. By the time the bents for the second span were ready, the ice was within 12



TIMBER TRAVELER REMOVES 480-FOOT STEEL BRIDGE IN THIRTEEN DAYS ft. of the floorbeams, which caused some difficulty in raising the 40-ft. bents to support this span.

The traveler was erected at one end of the bridge, and the interior struts and swaybracing were removed to the first panel point in the top chord. The trusses were then jacked up at the end and the top-chord pins driven out. After the first pin was removed the rest of the span was readily dismantled. As soon as one panel had been removed, the traveler would be pulled ahead with tackle to the center of the next panel.

The totals of the items shown in the table of the cost of the work are higher than would usually have been the case on account of the cold weather. Moreover, none of the men employed were familiar with bridge-erection work.

Estimated Cost of the Work

Hauling tools and material to job	$84.75
Hauling piles and bracing to job	318.00
Building falsework	646.00
Falsework, timber and pile material	744.37
Building and wrecking traveler	134.00
Material and tools for traveler	194.87
Wrecking, painting, hauling and storing 137.2 tons steelwork	674.90
Miscellaneous tools	146.38
Camp maintenance and building (6 weeks)	51.12
Camp equipment	86.84
Tool house	18.06
Transporting men to work	147.50
Cutting ice away from falsework (labor only)	227.60
Miscellaneous labor	35.08
General expenses	184.00
Total cost	$3,693.47
Salvage	464.70
Final cost	$3,228.77

The filling of the pond exceeded expectations, and, all things considered, rapid work was done in removing the steel before the ice and water reached the floor system. Only 30 working days were required for the entire job, and all the steel was removed in 13 working days.

Well-Drill Holes Should Be Shot Soon, But Not Too Soon

By EDWARD W. GOLDEN

H. W. Golden & Son, Inc., Troy, N. Y.

ON A RECENT CONTRACT considerable experience was secured with well drills used on a sidehill embankment of blue clay and hardpan with plenty of stones. The material being too hard and tough for economical handling with a steam shovel, blasting was resorted to. Holes 3 in. in diameter were drilled to a depth of 25 ft.

To work these drills to best advantage they must be set nearly perpendicular. Runways had to be cut on one side or built up on the other, and great care was required in moving over them. It takes so much time to lower the guides that it is usual to move a drill in working a trim. In the case of drills moved and operated by a tractor special care was required, much maneuvering being necessary to get the drill and tractor in line so that the drive belt would not jump off.

Small stones falling from the sides and collecting under the drill often greatly retarded progress, even though the material was of such a nature as to maintain the shape of the hole. Large stones also caused much trouble, as blasting to crack them and make a cavity into which the drill could force the fragments sometimes loosened stones in the sides of the hole and choked it to such an extent that it had to be abandoned. The blasting was done by lowering a stick of dynamite into the hole and covering it with mud before firing.

In bad weather it did not pay to let the holes stand too long before shooting. Even ground water sometimes loosened the sides of the holes, so that a great portion of the work was lost by caving. More than half of a 20-ft. hole was so lost on one occasion. On the other hand, if the charges are fired while the drill is near by, the explosion may close the hole on which the rig is working with the drill in it. Though it is not good policy to shoot too close to the shovel, it is sometimes worse to shoot too far ahead. On one occasion a number of holes were shot some time before the shovel could reach that section. In the meantime heavy rains occurred. Each one of the exploded holes acted as a sponge to collect water and hold it. When the shovel did reach this section, one of the worst mud holes imaginable had to be dealt with. The material was not only expensive to excavate, but it was almost impossible to get a bearing on it that would support the shovel.

Two Air Tools Remove and Clean 250 Paving Brick an Hour

By C. G. CUMMINGS

New York City

A PORTABLE gasoline-engine-driven compressor outfit supplying two small drills has been used by C. F. Crowley, Commissioner of Public Works of Troy, N. Y., to tear up brick pavements and clean the brick at a total cost of $5.96 per 1000, compared with a cost of $24 per 1000 for doing the same work by hand.

The outfit used is a single-stage 15-hp. Sullivan air compressor supplying a 25-lb. plug drill and a hand-bushing tool of the same manufacture. The plug drill is used for tearing up the brick and the lighter tool for cleaning the old grout from them. Old pavements can be torn up at the rate of 4 sq. ft. in 15 minutes, taking out one brick at a time or prying up several at once, as desired. Breakage is stated to be much less than

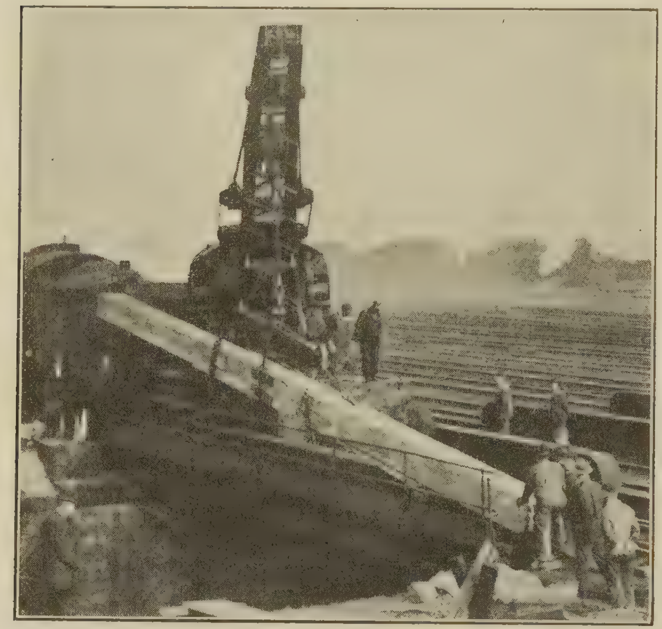
AIR TOOLS REMOVE BRICK WITHOUT BREAKAGE

when the work is done by hand. Previous to the development of this method it took 10 men to tear up and clean 1000 brick per day at a cost of $24. The operation of the compressor outfit, including oil and gasoline and the wages of an engineer and four workmen, cost $11.91 per day, and it is stated that the rate of progress with the two tools average 2000 brick removed and cleaned in 8 hours. Since this method was begun 767,000 brick have been cleaned with a total saving to the city estimated at $13,810. This is said to have paid seven or eight times over for the equipment, which is still in good condition.

Crane Places Precast Concrete Conduit of 50-Foot Span

By F. H. LEWIS
Altoona, Pa.

TO AVOID building falsework and constructing a concrete conduit in place over the Herr Street subway in the Harrisburg yard of the Pennsylvania Railroad, a section of conduit of sufficient length was built on a convenient spot near the subway and lifted into place with a locomotive crane. The section of conduit placed in this way, which has a 50-ft. span, is part of an underground system being constructed to eliminate overhead telephone and telegraph wires through a portion of the yard. It was reinforced according to usual practice. After the concrete had been allowed to set for four weeks, the crane picked up the beam, as shown in the photograph, and placed it without difficulty.



CRANE SETS SECTION OF PRECAST CONDUIT

Steel Car and Home-Made Tipple Put Cement Into Charging Hopper

BY C. LOUIS ZULL
Portsmouth, Ohio

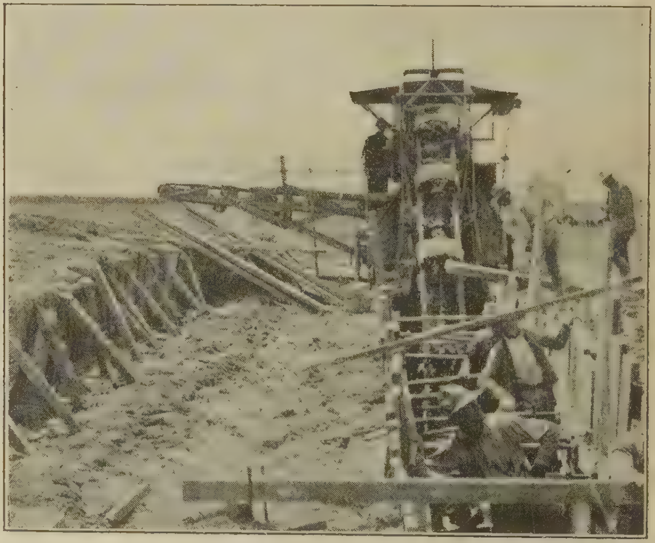
A SMALL steel car running on a four-rail track, with the inside rails bent down at the mixer hopper and the outside rails curled up to catch the rear wheels of the car, was used to put cement in the charging hopper of a concrete plant by the National Contract Company in the construction of Ohio River Dam 35 at New Richmond, Ohio.

The car consisted of a steel box about 2 x 3 ft. and 1 ft. deep, open at one end. This was mounted on four flanged wheels, the two on the front axle being set their thickness inside those on the rear axle. This car ran on a four-rail track, constructed on the charging platform between the door of the cement house and the hopper of the mixer. The outside rails extended out over this hopper about 1 ft. and were curved upward, while the inside rails were bent down inside the hopper. As the car reached the hopper, the front part ran down the inside rails, while the rear wheels caught on the curved outside rails, tilting the car body and discharging the loose cement into the hopper.

Two men emptied two bags of cement each into this car while the mixer hopper was full. As the hopper discharged into the mixer, one man let in gravel for the next batch, while the other drew the sand. The car was then given a light push when the cement was wanted. In this way only two men were required to charge each mixer. The writer was inspector for the U. S. Government on the work described.

Trench Machine Discharges Wet Muck Behind Plank Barrier

WET MUCK excavated for a trench on the Shoshone irrigation project of the U. S. Reclamation Service was prevented from flowing back into the trench by means of a plank retaining wall, shown in the photograph. Sheeting was placed closely behind the Austin trench machine and the low plank barrier was carried just ahead of it.



MUCK PREVENTED FROM FLOWING BACK INTO TRENCH BY PLANK LEVEE

High Crowns Are Doomed

It was formerly the rule to build a high crown on an earth road in order to shed water, but now that maintenance systems are being established it is found that a light crown on substantial earth construction is best.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

City Responsible for Safety of Public Buildings

Supreme Court of California Decides Against City of Long Beach in Municipal Auditorium Case

The city of Long Beach, Cal., was held liable by a decision of the State Supreme Court of California on March 2, 1916, for the deaths and injuries that occurred in May, 1913, when the municipal auditorium in that city was wrecked. Thirty-four people were killed and 117 injured when the pier on which the auditorium was erected collapsed. The structure gave way under the weight of 10,000 participants in the British Empire day celebration in commemoration of Queen Victoria's birthday. Accounts of the failure appeared in the News of the Week section of the Engineering Record of May 31, 1913, and on page 628 of the June 7 issue.

Following the accident hundreds of damage suits were filed, in which the total claims amounted to approximately $1,000,000. Investigation proved that the accident was due to the collapse of a girder which was originally too slender to bear the burdens intended for it and which was almost entirely decayed. The city of Long Beach op-

CONTINUED ON PAGE 445

New York Connecting Railroad Is Dedicated

Impressive Structure Providing All-Rail Route Between New England and the South and West Ready for Operation

Preparatory to the opening of the New York Connecting Railroad for through passenger service between New England and the West and South, the property was dedicated on March 9 to the transportation service of the country by Samuel Rea, president of the Pennsylvania Railroad Company. The special train which conveyed the party of directors and officers of the Pennsylvania, New York, New Haven & Hartford, and Long Island railroads which witnessed the ceremony was the first operated over the new line. It stopped for the dedication at the north end of the bridge across Hell Gate, which, with a span of practically 1000 ft., is the longest arch bridge in the world, and the last portion of the new line to be completed.

The section which is ready for operation, comprising the East River bridge division, was formally turned over by Gustav Lindenthal, its chief engineer and designer, to Samuel Rea, who then transferred it to the New York, New Haven & Hartford Railroad Company for operation as a part of its system.

This section of the New York Connecting Railroad, considered one of the most remarkable engineering structures in the world, is four-tracked, and includes besides the great arch span 3½ miles of steel viaduct on concrete piers and a mile of line carried on earthfill between concrete retaining walls, which depend for stability on tie rods extending through the fill. The entire road, when the freight branch is completed, will have cost more than $27,000,000.

Connection Proposed 25 Years Ago

The road, joining the New Haven system at Port Morris in the Bronx and the Pennsylvania system at the Sunnyside yard of the Long Island Railroad, provides direct rail connection through New York City between New England points and the territory south and west of the Hudson River, which was first proposed 25 years ago, when plans were afoot for a railroad bridge across the Hudson River at New York, and when the Steinway Tunnel was first projected. The inauguration of through-train service over this line will eliminate the necessity for transferring through passengers from one railway terminal to another across New York City, which has existed since the

TWO ENGINEERS WHO HAVE FOLLOWED THE PROJECT FOR A QUARTER OF A CENTURY TAKE PART IN OPENING RAIL CONNECTION BETWEEN NEW ENGLAND AND THE SOUTH VIA THE HELL GATE BRIDGE

Insert—Gustav Lindenthal, chief engineer, New York Connecting Railroad, and Samuel Rea, president of that railroad and of the Pennsylvania Railroad Company. Below (prominent engineers numbered) are—1, George Gibbs, consulting electrical engineer, Pennsylvania Railroad; 2, Samuel Rea; 3, Gustav Lindenthal; 4, E. B. Temple, assistant chief engineer, Pennsylvania Railroad; 5, L. V. Morris, chief engineer, Bay Ridge Improvement, Long Island Railroad; 6, A. C. Shand, chief engineer, Pennsylvania Railroad.

practice of transferring passenger trains by car ferry between New Jersey and the Bronx was discontinued some years ago.

Freight Connection Being Completed

The double-track freight connection of the railroad, extending from a point north of the Sunnyside yard to Bay Ridge, Brooklyn, has been completed, except for one section involving about a mile and a half of construction work near its northern end. This line will make the freight route between New England points and points reached by the railroads entering Jersey City more direct by eliminating the 20-mile ferry transfer up the East River and through Hell Gate. This route, difficult to navigate at all times, becomes dangerous in foggy weather. The new ferry transfer route between Bay Ridge and the Greenville yard of the Pennsylvania Railroad across New York Harbor will be only 3½ miles in length.

New York Engineers Indorse Diplomatic Break

Meeting of American Society Commends Assertion of American Rights and Urges Universal Service

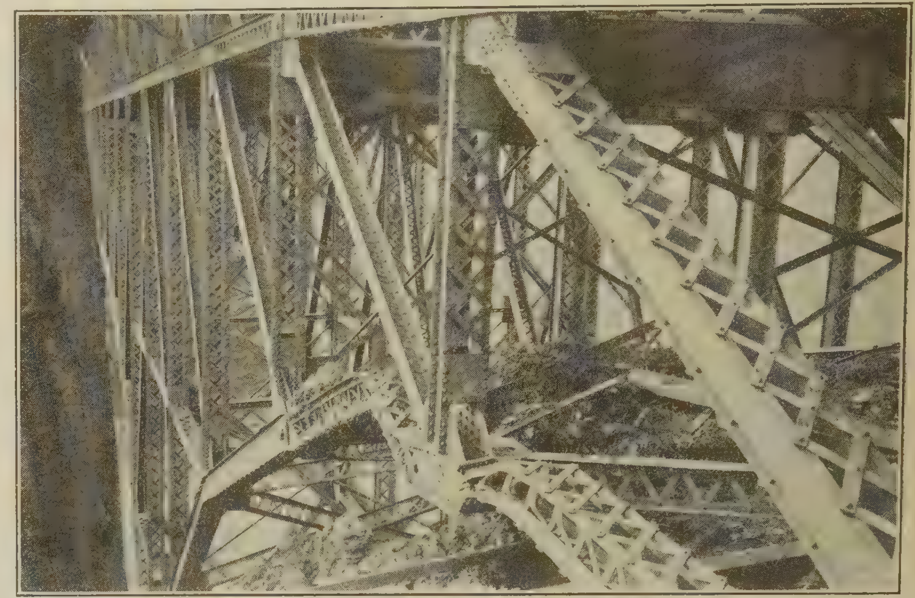
A resolution unanimously adopted at a meeting of the American Society of Civil Engineers in New York City on March 6 last commends the action of President Wilson in severing diplomatic relations with Germany and taking steps to protect American lives and property on the high seas. The resolution further states it to be the duty of engineers to assist the Government by rendering any service of which they are capable as individuals or as a body, and by urging Congress "to exercise its constitutional power 'to raise and support armies' by establishing immediately a permanent and democratic system of defense based upon universal service and training under direct and exclusive federal control."

It was ordered that a copy of the resolution be transmitted to the President and members of the Cabinet, and to the members of both Congressional committees on military affairs.

Slide Causes Collapse of Seattle Bridge Approach

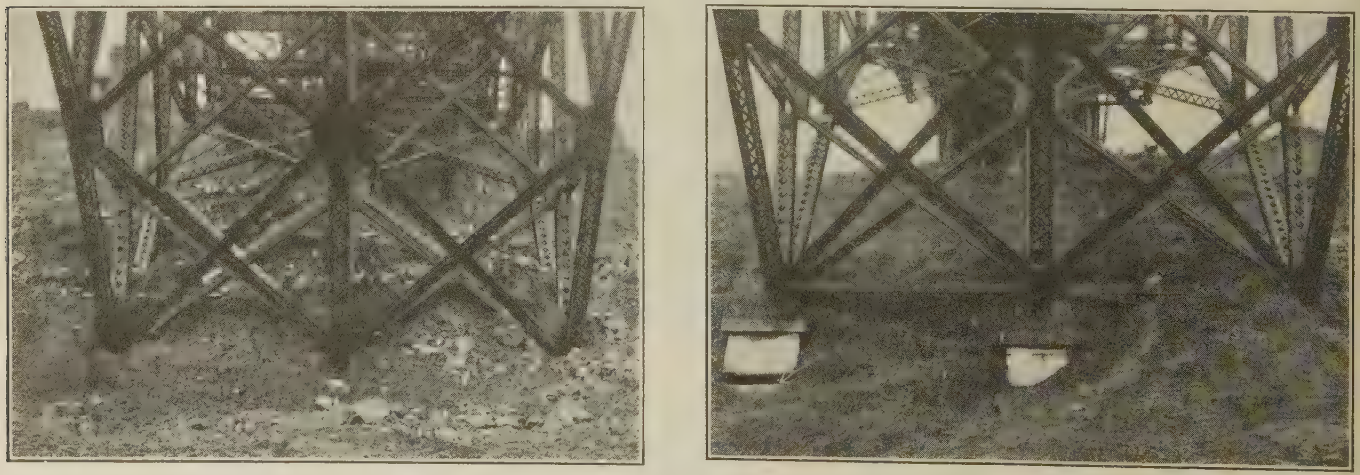
Lower Chords of Steel Cantilever Arm Buckled and Whole Structure Displaced—Pier Tilted

An earth slide on the sidehill at the Twelfth Avenue South bridge, in Seattle, Wash., on Feb. 26, caused the collapse of about 150 ft. of the timber approach on the south, badly buckled the lower chords of the steel cantilever arm of the main structure, apparently shifted the latter bodily toward the north, and caused one of the north supporting piers to tilt open at a construction joint. The accompanying photographs and the following data have been furnished by E. French Case of the Street and Sewer Department of Seattle. Fortunately no lives were lost, as the bridge had been closed to street car and vehicular traffic just one week previous by Charles R. Case, superintendent of streets and sewers, because a slight movement in the street had been noticed. This site is subject to such slides, one at the north end about two years ago entirely carrying out the piers at that end; in fact, the cantilever arms were designed to carry the loading without end supports just to anticipate such slides as actually occurred.



PRESSURE OF SLIDING EARTH BUCKLED THE LOWER CHORDS OF CANTILEVER ARM

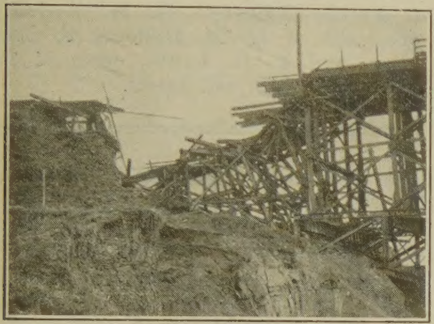
The main steel bridge is still supported on the intermediate concrete piers. The west pier on the north side parted below the anchor bolts at a construction joint, and made an opening in one side of the pier of 13 in., as is seen in one of the photographs. The condition of the other piers is not known, as they are covered with earth. The posts of the timber frame superstructure are inclined at an angle, showing the movement of the steel portion toward the north. The steel bridge is 361 ft. long, and was completed at a cost of $80,000 in 1912, as a part of the Dearborn Street regrade. A. H. Dimock was city engineer. The designing was done by J. W. Bowerman, of the firm of Bowerman & McCloy, bridge engineers of Seattle, under the direction of R. H. Thomson, who was then city engineer. Lewis & Wiley were the contractors, and the Penn Bridge Company supplied the steel, amounting to 550 tons.



LEFT—VIEW LOOKING SOUTH SHOWS EARTH COVERING PIERS; RIGHT—NORTH PIER OPENED AT CONSTRUCTION JOINT

The bridge consists of a center span 171 ft. long, and two cantilever arms 95 ft. long at each end. Expansion rollers were used on the south main pier only, and large pins in both main pier shoes were used to permit grade adjustment. Slotted holes and pins were adopted on the two outer panels of each cantilever arm to avoid a continuous structure, and also for the purpose of showing deflections and giving warning as to the condition of the ground on the slopes.

The steel portion of the bridge was built at an elevation of 90 ft above the center of Dearborn Street, and conforms to the proposed regrade of Beacon Hill. A timber frame superstructure roadway was built on the steel at an 8.54 per cent grade, so as to meet the existing streets on each side of the cut. This frame roadway is 395 ft. long and 110 ft. above Dearborn Street, and is supported by posts varying in length from 5 to 35 ft.



EARTH SLIDE CAUSED COLLAPSE OF TIMBER APPROACH ON SOUTH END

This bridge forms part of the main arterial highway from Beacon Hill district to the heart of the city—a large district covering a number of square miles, and quite thickly populated, with no approach on the west side of this hill to the south, and with only one approach on the north and east side, which is not paved.

Pressure on the steel bridge is being relieved by removing a portion of the slide and the wrecked approach material, which now rests against the members at the south end. It is planned to repair the steel portion of the bridge and to rebuild the approach.

Rhode Island Engineers Classified for National Crisis

The Rhode Island branch of the National Security League, with headquarters at Providence, R. I., has appointed a committee to classify the engineers of the state in order to ascertain how best they can be utilized for the protection and adaptation of the resources of that state in case of a national crisis. The classification is voluntary.

The headquarters of the subcommittee on engineering classification, which consists of William V. Polleys, chairman; Robert W. Adams and Robert L. Brunet, is at 1413 Turks Head Building, Providence, R. I.

City Responsible for Safety of Public Buildings

CONTINUED FROM PAGE 443

posed the damage suits, claiming it was not liable, as no rent had been paid for the use of the auditorium, and also taking the position that the municipality could not be sued.

But the Supreme Court in the decision rendered March 2, which was written by Justice Henshaw, and in which Justices Melvin, Sloss, Lorrigan and Lawlor concurred, decided these points against the city. The court held that while the legislature gives municipal corporations the right to erect and own municipal auditoriums, railroads, etc., it is not a governmental function and they are on the same footing as private individuals. They are responsible for the construction of buildings of this nature and for any accidents that might occur from faulty construction or negligence. The decision was based largely upon a former ruling of the court when it decided that the city of Alameda was responsible for accidents that occurred when it was conducting its own electric-light plant.

Cleveland Acts on Cuyahoga River Straightening

Petitions by County and City for Conservancy Board to Handle Proposition Well Under Way

To facilitate the movement in Cleveland toward getting the Cuyahoga River straightened, the Chamber of Commerce has recommended to the city and county officials co-operation between the city and county in securing the establishment of a local conservancy district. A resolution calling on the river and harbor committee of the city council to consider the advisability of such co-operation was passed March 7. Previously a subcommittee had reported its belief that the purposes of the conservancy act are broad enough to include the contemplated Cuyahoga River straightening project. Any or all of the following purposes which are to be named in a petition for the district will justify the exercise of such authority by the court: Preventing floods; regulating stream channels by changing, widening or deepening; reclaiming wet and overflowed lands; providing for irrigation where it may be needed; regulating the flow of streams, and of diverting or eliminating watercourses.

Advocacy of the establishment of a local district is influenced by the following considerations: That the industrial and commercial development of the river valley district is seriously hampered by the narrow, winding river channel; that flood damage in 1913 amounted to more than $1,250,000; that no recognized plan of realignment now exists. The plans recommended after the federal survey of 1912 failed to receive approval by the U. S. engineers. In view of the large number of public and private interests involved, the Chamber of Commerce sees a great advantage in having the problem handled by a body constituted only for that purpose.

The Chamber of Commerce recommended the tentative plan recently proposed by a special committee, consisting of Major Paul S. Bond, Engineer Corps, U. S. Army; W. S. Stinchcomb, county engineer, and E. B. Thomas, consulting engineer and member of the committee on river and harbor improvement, because it realized the advantage of having a concrete proposal by experts as a basis for study.

Engineer Appointments to Reserve Corps Continue

The following is a list of persons whose acceptances of appointment in the Engineer Officers' Reserve Corps, U. S. Army, have been received since the first list appeared in the Engineering Record of March 3, page 363:

Major—Samuel Hamilton Hedges, Washington.

Captains—John Stephen Doyle, Maryland; Ebert Allan Gibbs, Pennsylvania; Arthur H. Pratt, New York; Everett Bodman Murray, Missouri; Walter Owen Washington, Texas, and Willis D. A. Peaslee, Oregon.

First Lieutenants—Francis Olcott Allen III, Wisconsin; Karl J. Zinck, Oregon; John L. Desch, New Jersey, and Walter H. Dunlap, Washington, D. C.

Second Lieutenants—William M. Robinson, Jr., Georgia; Leo E. Fleischman, New York; Frederic W. Olmstead, New York; Paul S. Jones, Oregon; Happer K. Phelps, California; Arthur T. Fulkerson, Indiana; Frank F. Hutchings, Massachusetts; Jacob E. Eckstein, Pennsylvania; John P. Horan, Texas; Quincy Claude Ayres, Washington, D. C.; Gilbert Doolittle, New York; David M. Dunning, Jr., New York; Clay Warden Lewis, Missouri; George Dashiell Camp, Texas, and Edwin Caleb Burt, Washington, D. C.

Engineers of Southwestern States Organize Society

The Southwestern Society of Engineers was organized and a constitution adopted at a meeting in El Paso, Tex., March 8, 9 and 10. The primary object of the new society, as noted in the Engineering Record of March 10, page 404, is "the professional improvement of its members, the encouragement of social intercourse among engineers and the advancement of engineering knowledge, education and practice." The idea of the new organization was fostered rather than the formation of sections of the national societies because in the particular territory covered there are not sufficient members of any one of the national societies to form strong branch organizations, while about 1000 engineers within convenient distance of headquarters can qualify for membership in the new organization.

Flood Protection Planned by Los Angeles County

The plan for flood-protection work in Los Angeles County, California, for which a bond issue of $4,450,000 was recently approved, as reported in last week's issue of the Engineering Record, divides the work into four parts—(1) The construction of dams, both large and small, in the mountainous areas; (2) the protection of the banks of the smaller streams, together with spreading and storing of waters for beneficial use; (3) rectification through river-training and bank-protection of major streams, and (4) protection to the harbors of Los Angeles and Long Beach and their shipping interests.

The most important structures are as follows: On Pacoima Wash, a masonry dam, curved on a radius of 400 ft., 145 ft. high and 478 ft. long on top, with a storage capacity of 3200 acre-feet, to cost $359,460; a masonry dam at Devil's Gate, 130 ft. high, curved on a 400-ft. radius, to cost $290,000; the San Dimas dam, also 130 ft. high, and built on a 400-ft. radius, to impound 2500 acre-feet, to cost $278,000; the Pomona dam, to be of the earthfill type, 3300 ft. long, with a maximum height of 41 ft. The last-named structure will have a storage capacity of 2320 acre-feet.

Of the total bond issue, $60,000 is allotted to the work of building check dams in 17 cañon not heretofore so protected. The cost in each cañon ranges from $840 to $21,300. The harbor protection work is to consist chiefly of dikes and levees intended to confine flood waters to definite channels. Bridges will be built where main thoroughfares cross such channels.

The Board of Supervisors of Los Angeles recently agreed, in case the bond issue carried, to appoint three consulting engineers to review the plans being voted upon, which were prepared by J. W. Reagan, county flood-control engineer. The two of these consulting engineers already named are William Mulholland, chief engineer of the Water Department, and Major G. B. Pillsbury, federal engineer in charge of harbor work.

Discuss City Planning as a Metropolitan District Problem

Considered not as a problem for a single municipality, but rather as an opportunity for co-operation among groups of cities and towns, city planning for the Metropolitan District was the subject of a conference held at the City Club, New York City, March 10. Following an address, in which Nelson P. Lewis, chief engineer of the New York Board of Estimate and Apportionment, outlined the inter-relation of city and town planning, a committee was appointed to report plans for future action at a second conference to be held in a few months. Its members are Nelson P. Lewis and Frank B. Williams for New York City; Herbert Angell, Mount Vernon, N. Y.; Oscar Maddaus, Mineola, N. Y., and Arthur P. Cozzens, Newark, N. J.

One of the most pressing needs, it was pointed out, is for a comprehensive metropolitan highway system linking New York and New Jersey communities. Scientific planning principles, rather than legislative log-rolling, are needed in the layout of highway systems, according to Harry Meixell, Jr. In the larger cities, according to John T. Fox, transport expert to the committee on city plan of the New York Board of Estimate, too much time and too many changes of cars are required to reach suburban points.

Engineers in Commercial Association Lead in Patriotic Enthusiasm

Group 24, engineers, of the Denver Civic and Commercial Association, is taking the lead in that organization in rendering patriotic service. Sixty of them met recently and of their deliberations the *Commercial* says: "For numbers, intelligent procedure and downright enthusiasm it eclipsed any meeting of the smaller units of the organization that has yet been held."

At the meeting Chairman L. G. Carpenter explained details of the plan to take a human and physical census of the state's war resources. H. S. Crocker, consulting engineer, representing the American Society of Civil Engineers on the state board of directors of the Naval Consulting Board, explained what had been done by his board, and Arthur Ridgeway, assistant chief engineer, Denver & Rio Grande Railroad, told what services the government could expect from the railroads in the event of war.

Upon inquiry it was found that no point nearer to Denver than Kansas City or Yellowstone Park is available for the engineers to take examinations for the Officers' Reserve Corps. It is hoped to induce the War Department to send an examiner to Denver.

Hold Third Conference on Engineering Co-operation

Discussion of fundamentals of engineering co-operation outlined by the committee appointed last year is the object of the third annual conference on engineering co-operation to be held March 29 and 30 in the rooms of the Western Society of Engineers. Prof. F. H. Newell, chairman of the committee, has invited all the engineering societies whose names he could find and he states that none should stand on the formality of invitation, but send delegates.

In the discussion of the subject it will be shown, among other things, that as a preliminary to all efforts toward co-operation among engineering organizations there should be the expressed intent to assist in strengthening and unifying the work of the national engineering societies in the advancement of engineering knowledge and the practice and maintenance of high professional standards. Invigoration of local autonomous organizations will be shown to be fundamental. Welfare of members, ethics, employment, publicity and civic affairs are to be discussed. The committee believes that intermediate societies have no place, that the public engineer should be furnished sympathetic support, that occasional conferences should be held and that a field secretary should be supported to give personal advice and assistance toward efficiency and economy. The committee has expressed its views and the subjects are up for discussion and possible adoption.

At a dinner to be given March 29 under the auspices of the various engineering societies in Chicago, Hunter McDonald, past president of the American Society of Engineers and chief engineer, Nashville, Chattanooga & St. Louis Railway; C. A. Morse, chief engineer, Chicago, Rock Island & Pacific Railway; H. M. Byllesby, president of H. M. Byllesby & Company, and E. H. Lewis, dean of the Lewis Institute, will speak.

What Engineers and Contractors Are Doing

PAUL GENDELL, secretary of the Dubois (Pa.) Chamber of Commerce, has resigned that post to become superintendent of the employment office of the Emergency Aid of Philadelphia under the joint control of the Emergency Aid and the Pennsylvania Department of Labor and Industry. Mr. Gendell, one of the first engineers to become secretary of a chamber of commerce in Pennsylvania, has directed an industrial census of the entire city. He was manager of the Engineers' Society of Pennsylvania, with headquarters at Harrisburg before becoming secretary of the Dubois chamber. For ten years prior to that he was an engineer with the Pennsylvania Steel Company at Steelton, Pa. C. Lawrence Shepley, city editor of the Harrisburg *Telegraph*, Harrisburg, Pa., has been elected to succeed Mr. Gendell.

CHARLES SAVILLE, spoken of in the Engineering Record of March 3, page 333, as State director of Public Health, Texas, is director of public health of the city of Dallas, Tex.

JOHN C. PAYNE, assistant engineer of the Department of Commerce and Navigation, Trenton, N. J., and for many years engineer for the Board of Riparian Commissioners, has been appointed chief engineer of the department, succeeding B. F. Cresson, resigned.

H. S. FORNERI has resigned as city engineer of Eugene, Ore. He intends to open offices in San Diego, Cal.

O. J. DE SPAIN, county engineer, Adams County, Washington, has been appointed city engineer of Ritzville, Wash.

Robert L. E. Ward, recently with engineer department, central division, the Great Northern Railway, has accepted a position as assistant engineer with the Miracle Engineering Company of Great Falls, Mont.

William R. D. Hall, statistician of the Pennsylvania State Highway Department, has resigned his position and has been appointed manager of the publicity bureau of the Philadelphia Chamber of Commerce. Mr. Hall has been with the State Highway Department since October, 1913, where he was in charge of publicity and editor of the *Pennsylvania Highway News*.

W. A. VanDuzer, assistant engineer of the Pennsylvania State Highway Department, in charge of District 12, comprising the counties of Lackawanna, Monroe, Pike, Wyoming, Wayne and Susquehanna, has resigned his position with the department to engage in private business.

W. H. Bircher, of Scranton, Pa., superintendent of Lackawanna and Wayne counties, Pennsylvania State Highway Department, has been promoted to the position of acting assistant engineer in charge of District 12, vice Mr. VanDuzer, resigned. Mr. Bircher has been with the State Highway Department seven and one-half years in various engineering capacities. W. J. Devereaux, of Scranton, Pa., now chief of construction in District 12, has been appointed superintendent of Lackawanna and Wayne counties. Mr. Devereaux has been with the department six years. Edwin Bytheway, superintendent of Lehigh and Northampton counties, has resigned his position and the vacancy thus created has been filled by the appointment of H. G. Fenstermacher, of Allentown, Pa. Mr. Fenstermacher has been with the department for five and one-half years in various engineering capacities.

E. H. Shipman has been appointed chief engineer in charge of engineering construction and valuation of the Lehigh & New England Railroad, with office at South Bethlehem, Pa. Mr. Shipman, who was formerly superintendent of the railroad in charge of operation and engineering, was at the same time connected with the Lehigh Coal & Navigation Company, first as chief engineer on 106 miles of canal and since 1908 as canal superintendent in charge of operation and engineering in the canal department. He is a graduate of Lehigh University, class of 1888, and since graduation has continually been in active engineering practice.

Paul P. Stewart, chief engineer and treasurer, Ketler, Elliott Erection Company, has been appointed national director of the American Association of Engineers to fill the unexpired term of A. H. Krom, who resigned to become general manager of the association. Mr. Stewart was graduated from Yale in 1902 and for many years was connected with the U. S. Steel Corporation in charge of design and construction work at Gary, Ind. For a time he was professor of structural engineering at Ohio Northern University.

James P. Logan, Newark, N. J., has been appointed member of the Passaic Valley Sewerage and Drainage Commission, to succeed John J. Berry, Newark.

Edwin H. Verner, until recently municipal engineer of Port Coquitlam, B. C., Canada, has resigned to take a similar position at Langley, B. C.

Burwell Bantz, former county engineer, Island County, Washington, has opened an office in Coupeville, Wash., for the practice of civil engineering.

George H. Dawson, surveyor-general of British Columbia, has resigned his position and will resume private practice.

H. J. Harder, city engineer of Paterson, N. J., has been engaged by the Borough of Glen Rock, N. J., to make surveys and plans for a system of sewers.

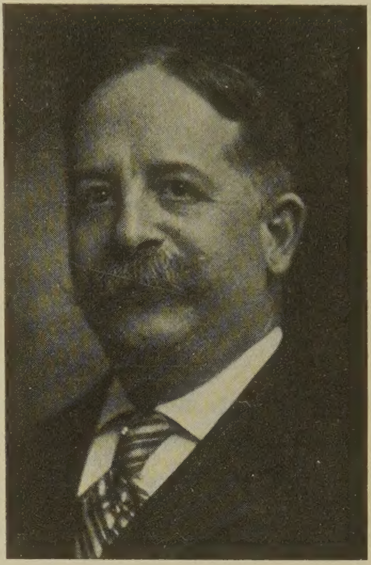
R. C. Carpenter, professor of experimental engineering, Cornell University, reaches the retiring age at the end of the present college year and will sever his active connection with the university at that time. Respecting his retirement, the committee on general administration of the board of trustees has adopted the following resolution: "Resolved, That the trustees in accepting the resignation of Professor Carpenter express their high appreciation of his services to the university for nearly thirty years. As a pioneer in the field of experimental engineering he is held in the highest esteem by all mechanical engineers, and by his writing in this field he has made an assured place for himself in the annals of his profession. As a teacher and investigator he is affectionately remembered by many generations of students and his retirement from the faculty of Sibley College will be viewed with great regret by all his colleagues." Professor Carpenter retires in good health and expects to maintain his activities in the fields of engineering investigation and research for several years to come.

J. J. Dwyer, president of the California State Board of Harbor Commissioners, has resigned his office.

Obituary Notes

John F. Alden, noted bridge engineer and representative of the American Bridge Company, died recently at his home in Rochester, N. Y. Mr. Alden, born in 1852, was a direct descendant in the eighth generation of John Alden of Puritan fame. He was graduated from the Rensselaer Polytechnic Institute in 1872. Following his graduation he was made assistant engineer in the construction of a bridge to carry the New York Central Railroad tracks across the Hudson River at Albany. In 1875 he became assistant engineer of the Leighton Bridge & Iron Works, Rochester, N. Y., and three years later became chief engineer and member of the firm. In 1880 he entered into partnership with Moritz Lassig of Chicago, when the Leighton Iron Works was taken over under the firm name of Alden & Lassig, with establishments in both cities. Later, after Mr. Alden had reorganized his business under the name of Rochester Bridge & Iron Works, of which he was sole proprietor until 1901, he sold out to the American Bridge Company, retaining an interest in the company up to the time of his death. Mr. Alden was connected with the construction of many bridges, especially for railroads. Among his works are sections of the elevated railroad in New York City, many bridges of the Delaware & Hudson Railroad, the Chicago, Milwaukee & St. Paul Railway, and others. He was also connected with the building of the bridge over the Columbia River at Pasco, Wash., and the upper suspension bridge at Niagara Falls. He furnished most of the steelwork at the Columbian Exposition, Chicago. In Rochester he erected, among others, the Driving Park Avenue bridge, which had been twice unsuccessfully attempted by others. Mr. Alden was a member of the Rensselaer Society of Civil Engineers and a former vice-president of the American Society of Civil Engineers, as well as a member of other engineering and scientific bodies.

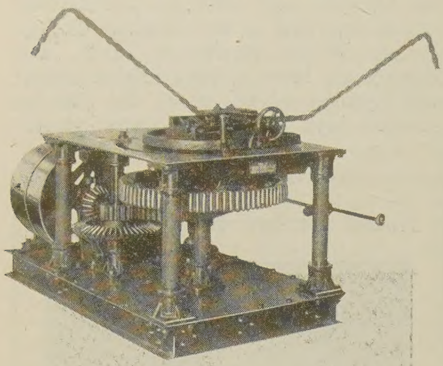
Noted Bridge Engineer Dies



JOHN F. ALDEN

Announce New Bar Bender

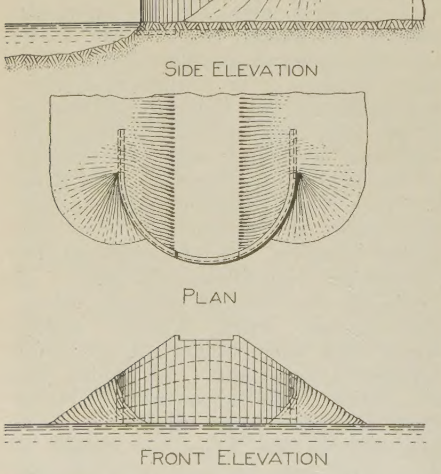
A new power bar bender, just put on the market, is said to bend bars up to 1¼ in. diameter at any desired angle. It has a vise arrangement to keep the rods in adjustment when making more than one bend. All wearable parts are said to be of cast steel, and the machine is arranged for any style of power drive. It is being manufactured by the McKenna Company, 1851 East Thirty-eighth Street, Cleveland, Ohio.



MACHINE SAID TO BEND BARS AT ANY ANGLE

New Type of Abutment Wall Patented

There were constructed in 1912-1913 in connection with the Keokuk dam across the Mississippi River, and under the supervision of Hugh L. Cooper, of New York City, several highway bridges and a new type of combined bridge abutment and retaining wall. Subsequently M. T. Thompson, the designer of these semicircular reinforced-concrete walls (typical plan and elevation of which are indicated by the drawing herewith) applied for letters patent, which were granted in September, 1916.



TYPICAL PLAN AND ELEVATIONS OF SEMI-CIRCULAR RETAINING WALL ABUTMENT

It is claimed that these walls have been entirely satisfactory, that the thickness required is much less than for standard construction, that the pressure of the earthfill is resisted by the weight and anchorage of earth around the rear extension of the wall and that this continuous curved type of reinforced-concrete wall is in no danger from unequal stresses such as often cause rupture in the usual form of abutment at the junction of the front wall and the wing walls. The chief claim made is for economy due to the use of less concrete—walls 28 ft. high and 15 in. thick, and later only 12 in. thick were constructed at Keokuk.

The Thompson Abutment Sales Company, Cuyler Building, New York City, has obtained the sole right to license builders of concrete abutments of this type.

Introduce New Rust-Proofing Material

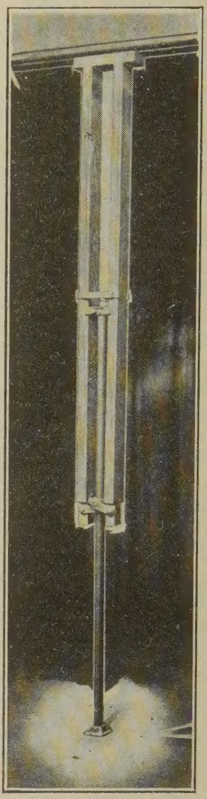
Announcement is made by Hess & Son, Philadelphia, Pa., of Epicassit, a metallic rust-proofing material lately introduced into this country from Germany. The coating is a metal powder mixed with a liquid carrier to the consistency of thick paint. It is applied with a brush and then melted on with a torch or in a furnace. It is said that the German Imperial Government testing laboratory at Berlin has reported that the material is proof against heat and cold and mechanical abuse, and is non-porous. A bright surface can be obtained by wiping the molten coating with a greasy cloth.

Form New Contractors' Equipment Company for Chicago

Mays & Talley, formerly agents for the Milwaukee Concrete Mixer Company, have combined with Walter B. Louer under the firm name of W. B. Louer Company, contractors' equipment. The offices of the new firm are on the ground floor of the Old Colony Building, Chicago, and have space to stock small parts and keep on hand a number of pumps and mixers. They will handle the Rex mixers, Pulsometer pumps, Novo engines, hoists, pumps, Parsons trench machines and backfillers, Lambert hoisting engines, Owen buckets, and a complete line of smaller supplies, such as hose, wheelbarrows, derricks and wire rope. The organization will have a permanent office in the Penobscott Building in Detroit, whose territory will include Illinois, northern Indiana, eastern Iowa and Michigan. There will be six salesmen assisted by two expert service men, who will devote their entire attention to the mechanical operation of machinery sold.

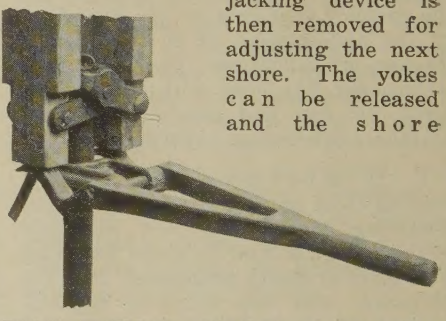
New Shoring Device Used on Concrete Formwork

A new self-locking, adjustable shoring device used in concrete construction is being manufactured by the H. W. Roos Company, Cincinnati, Ohio, which, it is stated, can be quickly set up and adjusted and later taken down by an unskilled laborer. The shores can be used repeatedly, are non-slipping and can be adjusted to any required height. As constructed for the average use, the shore consists of a 7-ft. lower member of standard pipe and an extension member of two legs of 2 x 4s, 8 ft. in length, with clamping yokes attached, the latter engaging with the pipe. This gives a shore adjustable from 8 ft. to 14 ft.



SHORE IS SELF-LOCKING

A jacking device permits of fine adjustment and a setscrew locks the yokes and prevents any possible release through outside jarring. The jacking device is then removed for adjusting the next shore. The yokes can be released and the shore taken down by loosening the yoke setscrew and tapping with a hammer on the yoke collar.



FINAL POSITION OBTAINED BY JACKING DEVICE

The price of the shore is $5.50 or $6, according to the length. The jacking device costs $5.

Trade Publications

International Harvester Company of America, Chicago. Almanac for 1917, 40 pages, illustrated.

Yeomans Brothers Company, Chicago. Bulletin B-3000, describing electric bulge pumps.

Victor R. Browning & Company, Cleveland. Folder describing single I-beams hand traveling cranes.